Prospects for Preventive Medicine

Ontario
Economic
Council

A Catalogue

Robert W. Morgan

Occasional Paper 2

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Robert W. Morgan

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Preface

This volume was produced in response to requests from the Ontario Economic Council and financed through a contract with them. The taxonomic approach taken in this report arose directly out of the request for a catalogue of prevention programs. Catalogues are, by definition, taxonomic. If the reader is overwhelmed with the negative tone of much of the volume, I apologize for being realistic. It is patently clear that the prospect for prevention lies not in the practice of medicine, but in the improvement of our environment and quality of life.

Chapter 1

Principles and Levels of Prevention

"An Ounce of Prevention is Worth a Pound of Cure"
- traditional proverb;

"A gram of avoidance/early detection may approximate one kilo of high intensity therapy" - a contemporary version of same.

The philosophy of prevention has changed only a little over thousands of years. Hippocrates suggested living on elevated hillsides rather than in malarial swamps. He continued a long tradition of physicians who had stressed prevention, especially through diet and modification of life style. Some of their emphasis on preventive medicine may have been due to their accurate evaluation of their ineffective treatments. As priorities, physicians placed prevention first, relief of discomfort second, and prolongation of life (cure) last. In this century, with the introduction of extensive and expensive medical technology, those priorities appear to have been reversed for many physicians, whose goals are now prolongation of survival, then patient comfort, and finally, prevention. These priorities have been ordered by a combination of technologic availability, public and profession expectations, and finally, the post-Flexnerian era which stresses "science" rather than humanistic skills in the practice of medicine. Only in recent years have we begun to doubt that applied science is the answer to the conquest of disease. Our survival rates for most of the major illnesses have not improved consequent to the introduction of more expensive and extensive technology. Better anesthesia has permitted bigger surgery; bigger surgery has not improved cancer survival rates. Better surgical techniques have allowed surgeons to bypass diseased coronary arteries; there is no evidence the operation improves survival. And while there is slowly increasing concern over the hazards inherent in investigation and treatment, the enormous hazards and incidence

of iatrogenic disease have probably been grossly underestimated. It may be that as many as one hospitalized patient in four will undergo some type of diagnostic or therapeutic misadventure or encounter a serious drug reaction (McLamb and Huntley, 1967; Schimmel, 1964). There have been some notable iatrogenic epidemics:

- the Sudbury anesthetic deaths (Toronto Globe and Mail, Jan. 18, 1974)
- thalidomide deformities (Mellin and Katzenstein, 1962)
- adenocarcinoma of cervix and vagina after stilbestrol (Herbst et al., 1971)

These and other tragedies have created a growing cynicism towards more and "better" therapy. Partly out of desperation, people now return to prevention to preserve health.

We distinguish three levels of prevention: primary, secondary, and tertiary. For primary prevention, we act so that a disease or injury does not occur. An example would be avoidance of smoking for prevention of lung cancer. Secondary prevention is the early diagnosis of disease for more effective treatment. An example is screening for breast cancer to identify an early stage of disease more amenable to treatment. Tertiary prevention is maximal rehabilitation from disease and its subsequent therapy. This text will concentrate on primary and secondary prevention, since tertiary prevention is only an extension of treatment.

Frequently, preventive medicine involves the identification of a target person before an apparent illness or before a person is himself aware of a medical problem. This presents a quandary for the practicing physician, since conventionally, a patient identifies himself as being ill and desirous of treatment. Thus the initiation for the treatment comes from the patient. In preventive medicine, the patient is likely not aware that he is ill or potentially ill; the health professional may have to initiate the contact to thus inform the patient. Since the bulk of physicians' time is devoted to treatment of disease rather than promotion of health or prevention of disease, preventive medicine as dispensed by practicing physicians tends to be coincidental rather than

planned. As a result, a large proportion of preventive medicine is dispensed in the form of public programs where public health authorities attempt to reach entire populations to deliver advice, immunizations, or other forms of prevention. As well as delivering individual doses of prevention (e.g. vaccinations), public health authorities also offer the population protection in the form of surveillance of water quality, air quality, and food safety. While the protective effects of environmental quality and food safety are extremely important to the health of the populace, they are not usually delivered in a health context. Rather, solutions entail engineering or applied microbiology.

Some important sources of environmental morbidity and mortality have not come under close surveillance by health authorities. The medical officer of health monitors the quality of our water, but not the design of our highways and intersections, although there may be more health dangers from the roadway than from the water main. Thus, public health programs are not designed to provide complete protection for the health of the public, but to combat traditional health hazards, with occasional forays into areas perceived to be poorly served by the private sector. For example, public health birth control clinics have been established, in large part, due to the reported reluctance of physicians to prescribe birth control to certain types of women and a reluctance of certain women to seek out private physicians for such advice. There is also a tradition of venereal and other infectious diseases to be treated in public health clinics, rather than private offices, presumably to facilitate detection and control of the sources of infection. Historically, private physicians may have lacked enthusiasm for treating these "public health" diseases, especially before antibiotics, when treatment was prolonged and often ineffectual. Treatment of tuberculosis by government health services probably arises out of both infectious disease control and the necessity of providing long term, expensive care to persons who could not afford to pay. Thus, public health became involved, not only because of an orientation toward prevention, but through financial necessity. Universal health

insurance has not moved treatment of these diseases back to the private sector; public health remains active because of history, expertise, interest in disease control, and because of the wide variety of social services sometimes needed.

The private physician usually practices treatment-oriented medicine and coincidentally a certain amount of preventive medicine. The public health physician dispenses preventive medicine to populations, with occasional extension to certain individuals, along with a limited amount of treatment for a few carefully specified diseases. There are certain other differences between programs delivered in the public context rather than through the private care sector. Public health programs are usually free of direct charges; they also receive more scrutiny and evaluation for both efficacy and cost than do most activities in the private sector. It should be realized, however, that most evaluations of preventive programs deal only in the short to medium terms; very few programs or procedures have been evaluated for their effect ten or more years later.

Preventive programs may be initiated for different motives. To reduce costs of compensation claims, an industry may embark on a noise abatement scheme to protect the workers' hearing. In this instance, the primary motivation may be financial, with improved health as a secondary benefit. The public health physician may open a birth control clinic to quieten vocal constituents demanding such services. By so doing, he expands his department, while appearing "progressive". Frequently, he will assess the success of the clinic by the number of persons and their satisfaction, rather than by any reduction in the local birth rate. The private practitioner may embark upon a glaucoma screening program because he likes to treat glaucoma; identification of more cases or suspects adds interest (and volume) to his practice. He likely views success in terms of new cases found, rather than amount of vision preserved. Thus, in comparing motivation for and evaluation of programs, one must be clearly cognizant of the program's underlying objective.

For the physician, the challenge and gratification provided by the quest for prevention differs markedly from that

provided by treatment of disease. With treatment, the enemy (disease) is apparent, the therapeutic armamentarium readily available, and the outcome reasonably unambiguous. In preventive medicine, the enemies are many and real, but often in the future, rather than present, while preventive measures are frequently vague, sometimes unpleasant, and exert marginal influence on an uncertain outcome. In preventive medicine, one is constantly faced with the problem: how does one count non-events? Thus curative medicine appeals to a decisive individual who can identify the problem and apply the appropriate remedy. Should the treatment be unsuccessful, there are a variety of explanations: the patient delayed too long; the patient did not comply with instructions; or the disease was more powerful than the available treatment. There is little element of failure on the part of the physician. In preventive medicine, the illnesses avoided may be supplanted by others even more odious; the patients for whom prevention is unsuccessful may be the only ones seen again; for those who do not get the disease, there is no proof that the intervention can be credited with their escape. In curative medicine, there is frequently an assumption that the patient who gets better does so because of treatment. As a result, curative medicine presents drama and gratification frequently absent from preventive medicine. It is little wonder that most physicians are more interested in disease than in health!

Some may also argue that under fee-for-service practice, treatment of disease is more lucrative than prevention. Experience with salaried physicians indicates, however, that mode of payment has but little effect on preventive practices. The salaried primary care physician usually practices no more preventive medicine than his fee-for-service colleague (Anderson and Crichton, 1973).

In promoting preventive medicine, we must avoid the "faith and fear" approach. Many surgical therapies are based on a fear of leaving the disease untreated and a certain blind faith in the effectiveness of the surgeon. For cancer we fear the knife less than the disease; we have more faith in mutilation than in natural immunity. Because fear of disease

still exists, and because through considerable experience our faith in therapy is diminishing, we are enticed by a new religion: prevention. Thus, we gladly receive exhortations to lose weight, abandon eggs, start running, and practice S.T.E. (self testicular examination) to prolong life and improve health. All of these programs have been advocated with little or no evidence that they will prove effective. Recently, some hybrid preventive-treatment programs have appeared. For instance, there are physicians who would screen the populace for asymptomatic coronary artery disease, submit the "abnormals" to coronary artery angiography, and operate on those with radiographic evidence of coronary artery narrowing. This program, ostensibly, is to prevent a future myocardial infarction. Do we really fear disease so much, and surgery so little?

The principle of preventive medicine is, where possible, to prevent the onset of disease or injury. In some infectious diseases, that objective might be modified; we may try instead, before an infection, to modify the host immunity sufficiently to allow infection, but with severity so diminished that we have prevented the "disease".

Primary prevention is generally considered to be the ultimate goal. Although usually based on knowledge of disease causation, preventive programs do not have to await complete knowledge. For example, we had reasonable evidence in 1951 that avoidance of cigarette smoking would prevent lung cancer. Twenty-five years of laboratory work since then, to identify the carcinogens in tobacco smoke, has not changed the solution: avoid cigarettes. A prolonged search for cause may be a "long-cut" to prevention.

We can divide etiologic factors into those necessary for production of disease (e.g. tubercle bacillus in tuberculosis) and those important but not absolutely required (e.g. cigarette smoking in lung cancer). Most non-infectious diseases have no one known necessary agent but a number of important factors we may consider eliminating. We must appreciate that in these instances, effective prevention will diminish but not eradicate the disease from a population. Even in infectious disease, one

may elect to eliminate the "non-essential" factors, rather than the biologic agent, to control the disease. For example, adequate nutrition may give considerable protection against infectious gastroenteritis in infancy (Gordon et al., 1964).

Should primary prevention not be feasible, we may adopt early diagnosis and treatment (secondary prevention) as a goal. The distinction between primary and secondary prevention is somewhat arbitrary, and may differ between individuals. For example, if we consider essential hypertension a disease, then mass screening programs for detection and treatment of this disease are programs of secondary prevention. No one, however, dies from uncomplicated hypertension. Most death due to hypertension can be attributed to cardiac causes, strokes, and kidney disease. Effective treatment of the hypertension will reduce the number and severity of the strokes. Thus, secondary prevention of hypertension may well be primary prevention of strokes.

In screening, there is frequent uncertainty as to what differentiates a disease from its normal physiologic precursors. As an example, a person may feel well and look well but have an abnormal glucose tolerance curve. Is he diabetic if there are no other manifestations of the disease? If we treat that individual with weight loss and carbohydrate restriction, are we practicing secondary prevention on a diabetic or primary prevention in a person at high risk of later diabetes onset? While such distinctions may appear academic, they soon become important when one looks at the objectives of various preventive programs. Fortunately, many situations are clear-cut. We avoid smoking to prevent coronary disease and lung cancer. This is clearly primary prevention. By palpating women's breasts to detect cancerous masses we practice secondary prevention. There is an unfortunate tendency for many people, especially physicians, to equate early diagnosis with prevention. This probably arises because secondary prevention tends to be practiced in the health context, where primary prevention is less common.

Secondary prevention is closely related to the concept of screening, defined as "the presumptive identification of

unrecognized disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly. A screening test sorts out apparently well persons who probably have a particular disease from persons who probably do not have the disease. It is not intended to be diagnostic." (Wilson, 1968). For successful secondary prevention, this screening must then be combined with effective treatment to produce a population that will be healthier than one which has remained unscreened, and presumably untreated. Table I is a set of criteria concerning screening. Although published in 1968, it is still appropriate, except for minor modifications which I have included. Few, if any, screening measures can meet these criteria. Specific tests will be discussed in later chapters.

In the interests of efficiency, batteries of various screening tests have been put together to be administered at a single visit. This is known as multiphasic screening and has been popular at a number of centers, the most noted of which are the Kaiser-Permanente clinics operation in California. In spite of the efficiency gained by multiphasic screening, there is little justification for putting together whole series of tests which do not, individually, meet criteria for effective screening. Although some preliminary reports have appeared (Cutler et al., 1973; Ramcharan et al., 1973; Dales et al., 1973; Collen et al., 1973), the ultimate long term evaluation of the effect of multiphasic screening of a large population has not yet been published. Should the procedure prove effective in reducing morbidity or mortality, the epidemiologic community will be most surprised.

Table 1. PRINCIPLES OF EARLY DISEASE DETECTION*

1. The condition sought should be an important problem.
2. There should be an effective treatment for patients with recognized disease.
3. Facilities for diagnosis and treatment should be available, and more effective, when applied early.
4. The natural history of the condition to be sought should be adequately understood.
5. There should be a suitable test or examination to detect disease with a high degree of sensitivity and specificity.
6. There should be a recognizable latent or early symptomatic stage.
7. The test or examination should be acceptable to the population and health professionals.
8. There should be an agreed policy on whom to treat as patients.
9. Case-finding should be a continuing process.
10. The cost of early diagnosis and treatment should be economically balanced against the benefit of early treatment in terms of prevention of disability or death.

* Modified from Wilson, 1968.

The hazards of screening are frequently overlooked. A man who leaves a screening test after having been told that he is free of a certain disease may then neglect symptoms of that disease due to the false reassurance given to those individuals who give a "false negative" test. Likewise, there is a hazard to every diagnostic and therapeutic procedure; the "false positives" will have to undergo this hazard, as well as those persons with the disease who would not normally become aware of the disease or receive treatment. It is generally considered that a screening test should be highly sensitive so that practically all persons with the disease are correctly identified, even if it means a high rate of false positives. However, since most diseases are of relatively low frequency in the screened population, and the true negatives far outweigh the true positives, a modest percentage of false positives among the true negatives may mean that the majority of persons with positive tests are, in fact, false positives. This then exposes more people to hazards of further diagnostic assessment and treatment.

In Table 2, sensitivity represents the proportion of diseased people identified by the test. Specificity refers to the proportion of disease-free persons correctly identified. Assume a sensitivity of 90% and specificity of 80%. For a disease with a prevalence of 100 per 1,000 we would obtain results as in Table 3. Note that two-thirds of persons with a positive test are disease-free.

If we consider a less prevalent disease than previously discussed, our results change. Table 4 considers a disease with a prevalence of 10 per 1,000 (somewhat more frequent than carcinoma of the cervix). Here, for every 207 positive tests, only 9, or less than 5%, indicate actual disease. If we attempt to improve test efficiency, we must increase specificity, that is, our ability to correctly identify people without the disease. This creates difficulty, however, since conventional medical thinking considers the "false negative" error much more serious than the "false positive". Yet specificity can only be increased at the expense of diminished sensitivity. An alternate solution would be to select for screening only those

Table 2: SENSITIVITY AND SPECIFICITY IN SCREENING

		TRUTH		
		Disease	No Disease	
TEST	Positive	a	c	a+c
	Negative	b	d	b+d
		a+b	c+d	N

Sensitivity = $\frac{a}{a+b}$ Specificity = $\frac{d}{c+d}$

Table 3: FREQUENCY OF POSITIVE AND NEGATIVE TESTS WHERE PREVALENCE OF DISEASE 10%, SENSITIVITY .9, SPECIFICITY .8

		TRUTH	
		Disease	No Disease
TEST	Positive	90	180*
	Negative	10	720
		100	900

* Note that two-thirds of person with a positive test are disease-free.

Table 4: FREQUENCY OF POSITIVE AND NEGATIVE TESTS WHERE PREVALENCE OF DISEASE 1%, SENSITIVITY .9, SPECIFICITY .8

		TRUTH	
		Disease	No Disease
TEST	Positive	9	198*
	Negative	1	792
		10	990

* Note that over 95% of persons with a positive test are disease-free.

populations with higher prevalence rates. This will greatly increase the program's efficiency.

There are basically three reasons to attempt prevention of disease on any large scale. Priority is given to the most frequent causes of morbidity and mortality. Our decision here may be weighted by the severity of the morbidity and its need for health care resources. We are anxious to prevent the diseases which affect the very young, since there are potentially many years to be saved by prevention of childhood mortality. Also, prevention of severe childhood morbidity may reduce the prevalence of disability in later life. Certain occupations may come under intense surveillance for public protection: a health problem in an airline pilot could have disastrous consequences for the public health. Finally, some preventive programs are instituted or maintained because of their ease or possibility of success. Thus, many persons receive smallpox vaccinations, not because smallpox is any particular threat, but because the prevention is so easy.

There are certain hazards in using the previously stated criteria to identify preventive programs. If one used disease frequency, there is a danger that unproven or marginally effective preventive programs will be employed out of a sense of desperation, merely because of the numbers of people involved. In applying any preventive technology, one must be aware that there may be unknown dangers. For instance, consider the history of phenylketonuria (PKU) testing. PKU is a relatively rare disease, frequently leading to mental retardation in those affected. Because it produces a biochemical abnormality, it was not difficult to perfect a simple urinary test for use as a screening device among newborns. Unfortunately, the early test, while it correctly identified many persons with the disease, missed some victims and incorrectly identified some normal children as having the disease (Scriver, 1967). The treatment of PKU is a special diet which, while expensive, will improve the I.Q. of a child with metabolic defect. The same diet, given to a child without PKU, will cause mental deficiency (Rouse, 1966). Thus, the original screening test - cheap and simple in principle and leading to a readily available therapy - had

unrecognized dangers at the time of introduction. In another instance, a certain provincial cytology program was advocating annual cervical cytology for every woman over age 20. During one particular calendar year, three of the women operated on for carcinoma in situ died of infection during the immediate post-operative period. We do not know whether all of these three women would have gone on to develop invasive disease, or whether they would have in fact died from invasive disease, had they contracted it. We do know that the operation for in situ carcinoma dramatically shortened their lives. Thus, a simple "preventive" technique may have disastrous consequences for certain individuals.

PRIMUM NON NOCERE.

Chapter 2

The Measurement of Health, Disease, and Health Care Effectiveness

It is customary to measure sickness rather than health. The World Health Organization defines health as a "state of complete mental, physical and social well-being, and not merely the absence of disease". The firmest measure of the non-health of the population lies in mortality statistics. For every death, cause is recorded and eventually coded according to the International Classification of Disease. Unlike health, the state of death suffers from little ambiguity. There is reasonable assurance that all persons so registered are indeed dead. The causes of death are not quite as believable, although in a province like Ontario, one can have a reasonable degree of confidence in the published statistics. We know that there are regional differences in reporting. For instance, some areas of Canada report more deaths from chronic bronchitis and fewer from emphysema than to other areas (Anderson, 1963). So, although the relative proportion of people dying from the sum of these two diseases may be similar from province to province, regional variation will attribute those deaths to different causes. There is also some evidence that persons who have, at any time in their life, received a diagnosis of carcinoma are more likely to have this diagnosis appear on their death certificate - even though the carcinoma may not be the underlying or even contributing cause for that individual. These biases are probably minor in the use of vital statistics to identify the major disease problems.

Vital statistics also give us rates for births, stillbirths, and the frequency of congenital anomalies among those born. Here, too, there are reporting errors, including an under-reporting of stillbirths and a gross under-reporting of congenital anomalies, due to a combination of physician indifference and diagnostic inaccuracy (only partially avoidable).

Morbidity is usually measured by hospital admissions,

recorded use of physician services, or community survey. All three estimates contain large sources of error. Hospital admission statistics, for instance, do not usually differentiate between persons re-admitted and those newly admitted. Consequently, the number of admissions considerably exceeds the number of individual persons admitted. Likewise, admitting and discharge diagnoses may be quite different and are subject to a number of errors in coding and transcription. Provincial statistics are based on discharge diagnoses; some smaller systems such as the Hospital Medical Records Institute may be able to identify individuals, as well as hospitalization episodes.

The use of physicians' services has been measured in a number of ways, including diaries of practitioners, tabulation of health insurance data, and by community survey. Except for a few meticulous individuals, most physicians are not likely to keep a complete log (including diagnoses) for more than a very short period of time. Researchers have been reluctant to use medical insurance data extensively because of the possible inaccuracies of diagnosis recorded on medical insurance forms. These data may not be all that bad: some serious diagnoses are probably accurately reported, while minor complaints or sensitive diagnoses like venereal disease are under-reported. Currently, medical insurance plans do not analyze morbidity data on a routine basis, so ongoing morbidity information is not available in this country. Obviously, both the physician diaries and medical insurance billing forms record only those conditions and episodes for which treatment is sought. Most health problems are treated by the patient, his family, and various persons in the community other than physicians.

The community survey has been used extensively to measure morbidity. This approach suffers from all of the usual problems of survey research, including non-response, poor recall, and concealment. As a typical result, of those persons who admit to seeing a doctor in the past two weeks, about two-thirds report having made their visit during the most recent week, and one-third during the previous week (Mooney, 1962). As another problem, the researcher often attempts to construct a picture of

continuing health events from a cross-sectional survey, which usually best measures those conditions most prevalent at the time of the survey. While recurrent disease or brief episodic illness may both appear in the results, chronic disabilities may dominate the statistics. Unfortunately, this aspect of survey research is not always recognized. As health problems, diseases of incidence (see below) may be more important than diseases of prevalence.

The reader should be familiar with the terms 'prevalence' and 'incidence'. 'Prevalence' refers to the amount of disease in a given population at a point in time. Ideally, all of the persons in the denominator should be at risk of entering the numerator; all of the numerator should arise from the denominator population. It is customary to express this as a rate per 100,000. For example, the prevalence of electrocardiographic abnormality on stress testing is approximately 30 per 100,000 males over age 40. That statistic applies only to the point of time at which the survey was taken. The term 'incidence' refers to events happening over a period of time in a specific population. For instance, the 1974 Ontario death rate (an incidence rate) for males age 65 to 69 was 3,470 per 100,000. Naturally, incidence and prevalence are related by time. High incidence and long duration of disease will create a high prevalence in a population survey. If, through successful secondary prevention one increases the duration of the disease by prolonging life, prevalence should also increase. If one is exercising good primary prevention, both incidence and prevalence should fall. A screening program which identifies previously unrecognized disease may apparently increase both incidence and prevalence, without necessarily affecting the disease natural history.

The usual algebraic equation demonstrating the relationship of prevalence, incidence, and duration is:

prevalence = incidence X duration

(assuming a steady state for all three variables)

The equation itself is of limited value since few of the variables are sufficiently constant to be reliable. The greatest use for the equation is to understand the effects on

the other two variables when one changes, especially by measurement, any one of the three.

Many persons, including physicians, fail to realize that the definition of "disease" is not always clear. For example, some ophthalmologists diagnose glaucoma solely on the basis of an elevation of intraocular pressure; others will require evidence of visual field defect; and others will also need to see an abnormality of the optic nervehead. Since disease definitions are ambiguous, the physician who "beats the bushes" to find cases may well increase the incidence and prevalence of the disease. By finding the milder cases (or non-cases) his treatment results may well improve. Thus, the cost of caring for Disease X is not just a function of the biologic incidence or prevalence of that disease, but also a function of physician awareness and enthusiasm.

We may even find the apparent incidence or prevalence of disease affected by availability of therapy. Is the menopausal syndrome now seen more frequently because both patient and physician consider it a treatable condition rather than an inevitable discomfort? Certainly the exponential growth of coronary artery bypass surgery, and its precursor, angiography, may reflect, in part, an increased interest in angina pectoris, with resultant increased frequency of diagnosis.

As discussed earlier, mortality data are much firmer than morbidity data, since death is an unambiguous event which also happens to require extensive documentation. Morbidity may be considerably less well defined and frequently produces no documentation. Table 5 and Figure 1 (for Fig. 1 see insert, inside back cover) reflect mortality in Ontario and Canada respectively (Province of Ontario Vital Statistics for 1973; Lalonde, 1974). These clearly demonstrate the overwhelming importance, in terms of life years lost, of accidents and violence. Until after age 35, accidental and violent deaths account for more than 50% of all mortality. Cancer, which appears as one of the top three causes in all categories after age 1 year is much less frequent until after age 35 and especially after age 45 or 55. It has been estimated that if cancer were to be totally eradicated, life expectancy would

increase from 2 to 7 years, with the lower figure being more likely. This is not to deny the importance of prevention of diseases such as cancer, but to demonstrate that large reductions in mortality will not occur unless we can effect prevention of accidental and violent death.

Table 5: DEATHS BY CAUSE AND SEX,
RESIDENTS OF ONTARIO, 1973
ALL AGES COMBINED*

Cause of Death	Male	Female
Diseases of the circulatory system	28.04%	23.30%
Neoplasms	10.98%	9.17%
Accidents, poisoning, and violence	6.18%	2.70%
Diseases of the respiratory system	4.04%	2.48%
Diseases of the digestive system	2.24%	1.58%
Endocrine, nutritional, and metabolic diseases	.97%	1.19%
Perinatal mortality	.85%	.65%
Diseases of genitourinary system	.68%	.41%
Diseases of the nervous system and sense organs	.58%	.44%
Congenital anomalies	.41%	.44%

* Adapted from Province of Ontario Vital Statistics for 1973

Chapter 3

Criteria of Effectiveness

An effective preventive program should reduce one or more of the following:

mortality
incidence
severity
duration

Paradoxically it may appear to increase one or more of those measurements while reducing others. Consider, for instance, a program of primary prevention. While being truly effective in reducing both incidence and mortality, it may appear to actually increase these as a result of improved reporting of disease consequent to introduction of a preventive program. This reporting artifact is probably more important for programs of secondary prevention, that commonly appear to increase incidence, duration, and mortality from a disease. Consider the effects of introducing a screening program for cervical cancer. This program will:

1. Increase incidence through finding cases that would otherwise never be counted or by increasing reporting of disease due to improved surveillance;
2. Increase duration of disease by finding incurable disease earlier and thereby artificially lengthening the period of disease under observation (survival time);
3. Increase reported mortality since once a woman receives the diagnosis of cancer it tends to reappear on her death certificate, whether or not it was the true or underlying cause of death.

Effective programs of secondary prevention should usually decrease the case fatality rate.* In evaluating such programs

* Case fatality rate = $\frac{\text{No. of persons dying of disease}}{\text{No. of persons with disease}}$

however, there are a number of dangers:

1. The screening may uncover mild cases that previously would not have been discovered or counted;
2. The screening may falsely identify some healthy persons as diseased;
3. Changing both numerator and denominator of the case fatality rate renders historic (pre- and post-screening) comparisons invalid.

The five-year survival rate is a favorite method for surgeons to evaluate success. A woman operated on at age 42 and dying at age 44 has a 2 year survival, one of the "failures" for five-year survival. Had the same person been diagnosed and treated at age 38 and still died at age 44, she would be considered a "success". Clearly, moving forward the surgical date is not enough for a successful screening program; it must also move back the death date. This evaluation is best accomplished by proper use of life table methods rather than examination of 2, 5, or 10 year survival rates.

In evaluating effectiveness of treatment or prevention, one must be wary of historical comparisons. For example, the building of sanitaria, introduction of chest surgery, and discovery of antibiotics has each been credited with a dramatic decline in tuberculosis mortality. Without doubt, mortality fell after each of these innovations, unfortunately only enough to maintain the slope of mortality decline established long before any of these discoveries. It is perhaps possible that the slope would have flattened or even reversed without such therapeutic advances, but we have no way of testing such a hypothesis. We do not claim the new therapies were worthless; rather, we wish to promote skepticism concerning historic comparisons as valid evaluation.

As another example of historic comparison under fire, consider the British Columbia cervical cytology program, frequently cited as a model to be emulated. The principal proponents have been pleased to point out the decline in mortality from carcinoma of the uterine cervix after introduction of cytologic screening (Boyes and Fidler, 1963; Fidler et al., 1968). Other authors have since pointed out that

other provinces, without similar programs, experienced a similar decline (Ahluwalia and Doll, 1968; Sellers and McLerie, 1973). A different comparison finds the truth somewhere in between (Miller et al., 1976).

There are some preventive programs that are clearly effective. Smallpox vaccination, although never evaluated in a double blind trial, has brought us to the prospect of smallpox eradication in 1976. Poliomyelitis vaccine has been well evaluated and proven effective. The same is true of most other immunizations and fluoridation.

Some programs are probably effective but still lacking in sufficient data. Screening for breast cancer appears to work well for women over the age of 50 (Strax et al., 1973), but our information is restricted to only one study, unlikely to ever be repeated because of cost. For some programs generally thought to be effective, some rather equivocal evidence now suggests that these programs are either less effective than thought, or without positive effect. Examples include such traditional public health activities as venereal disease case finding (Blount, 1972; Marino et al., 1972) and rheumatic fever prophylaxis (Markowitz, 1970).

Some attempts at prevention have met with marked failure. Screening for lung cancer has proven ineffective although both mass x-ray surveys, at various intervals, and cytologic examination of sputum have been tried separately and in combination (Miller, 1973). In this disease, progression is probably so rapid that early detection and treatment will never succeed. As a humorous example of failure, consider the trial of a gonorrhea vaccine in the Canadian Northwest Territories. While logic would say that no vaccine for gonorrhea would ever work because we have ample evidence that one infection gives no protection against subsequent infection, the trial proceeded. One group of volunteers received a placebo, another group received the vaccine. Those receiving the vaccine had higher re-infection rates than those with the placebo. Perhaps the subjects "broke the code" and dashed into the community, assuming protection.

I suggest five criteria for effective programs:

1. The disease must be important through at least one of the following:
    a. frequency of morbidity
    b. frequency of mortality
    c. long term sequelae, disability
    d. cost
    e. ease of prevention
2. The program must do one of the following:
    a. protect against disease onset
    b. delay disease onset
    c. lessen the disease effects on the individual
    d. reduce the cost of treatment
3. Morbidity and mortality created by the program must be less than the gains made.
4. The program must be affordable.
5. The program must be acceptable, preferably to both consumers and professionals.

The above criteria are relatively simple, and most of them have been alluded to earlier in the text. The question of whether or not a program is affordable is perhaps the most controversial. Program costs are easily identified; disease costs can defy measurement. In assessing the various costs and benefits, it would seem that such an exercise is only partly in the field of economics. Society may decide to proceed with an expensive program because of the anguish produced by a certain disabling condition. The decision can not be left solely to economists or to physicians, but both should participate. The ultimate decision may well be political. Physicians have known for years that seat belts protect against severe injury and death; economists had calculated the number of hospital days (and costs) to be saved; only a political decision was finally able to affect the life style and risk of every citizen of Ontario.

Chapter 4

Health and the Health Field Concept: A Five Dimension Matrix

Throughout history, man has produced a number of models to explain disease occurrence. A fatalist might argue that no amount of evasion or environmental manipulation will affect prevention of a certain fate. Some religions extend this approach to consider fate as the will of a god, who may or may not be influenced by human behaviour, including prayer. In some instances, life on earth, with disease and discomfort, was considered a necessary discomfort to be endured prior to proceeding on to a permanent and presumably healthy paradise. All of these approaches impose severe limitations on the practice of preventive medicine.

Causal thinking moved forward with the identification of various environmental agents, especially bacterial, involved in disease production. An elaborate set of criteria (Koch's postulates) were required to test the disease model:

Man + Organism → Diseased Man

This model, extremely prevalent in contemporary thought, is probably responsible for much preoccupation with "the cause" type of thinking with regard to disease. How simple it would be if tubercle bacillus was the only cause of tuberculosis, if animal fat the only cause of coronary artery disease, or if smoking the only cause of lung cancer. This model, however, is far too simplistic to properly explain disease or the lack of it. All of us have inhaled tubercle bacilli: few of us ever developed disease; most of us eat large amounts of animal fat: many of us will escape serious coronary disease. Some of us, though non-smokers, will die of lung cancer.

We probably escaped tuberculosis because of a number of factors, including our immune status, nutrition, level of stress, time of exposure, freedom from poverty, lack of over-crowded living conditions, and lack of exposure to very large numbers of freshly excreted virulent organisms. Thus, our protection came from within (host factors) and from without (environmental factors). Because of our experience with

diseases such as tuberculosis, the epidemiologic model of diseases was devised (Fig. 2).

There are no diseases or medical conditions which do not fit the epidemiologic model, which recognizes the interplay of all three factors in production of disease. Naturally, each point of the triangle may have a long list of sub-factors. For tuberculosis, some of these have been mentioned as host and environmental factors (see above); agent factors would include number, viability, and virulence of the bacteria.

While the epidemiologic model is admirably suited to the study of multi-factorial etiology, it is perhaps less applicable or less frequently used in the context of medical treatment. One attempt to organize this area is the Health Field Concept proposed by H. Laframboise (1973) and M. Lalonde (1974), who suggested that health problems could be broken down into four elements: human biology, environment, lifestyle, and health care organization. This would appear to be an extension of the epidemiologic model, with the former Agents Factor now appearing as either human biology or environment. Lifestyle, which might have been thought to be the interaction of the host and environment, has now become a separate element; and health care organization has been added. The Health Field Concept is essentially analytic rather than dynamic. While it may be useful in creating organizations or setting priorities, it has not had extensive application to examination of disease processes. It might have considerable usefulness in planning preventive programs.

The following model is an attempt to integrate both the traditional epidemiologic model and the health field concept into a more useful paradigm (Fig. 3).

Figure 2: The Epidemiologic Model of Disease Etiology

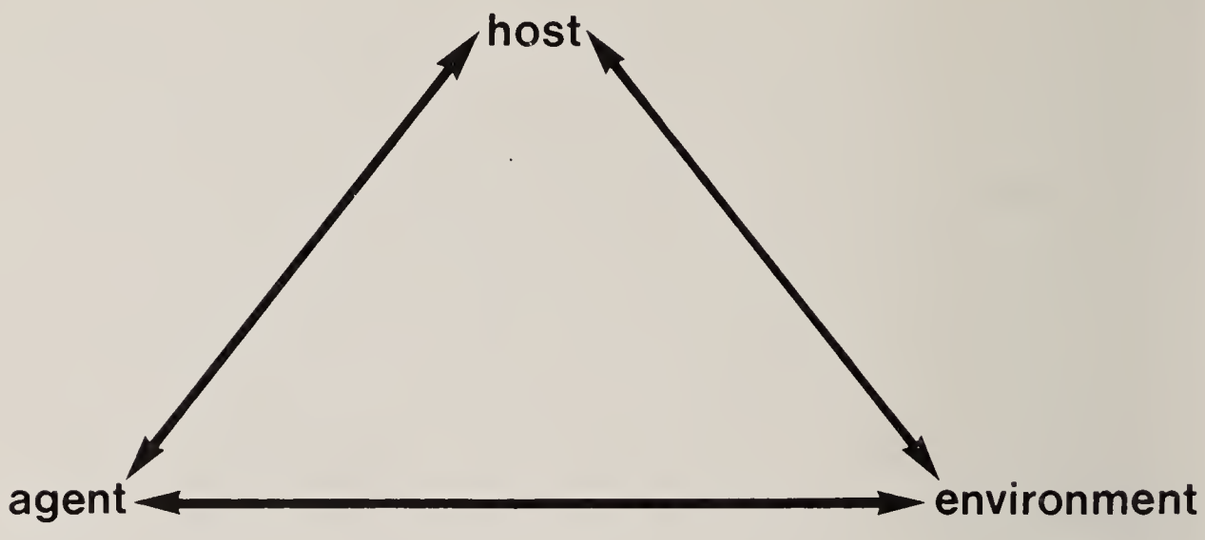
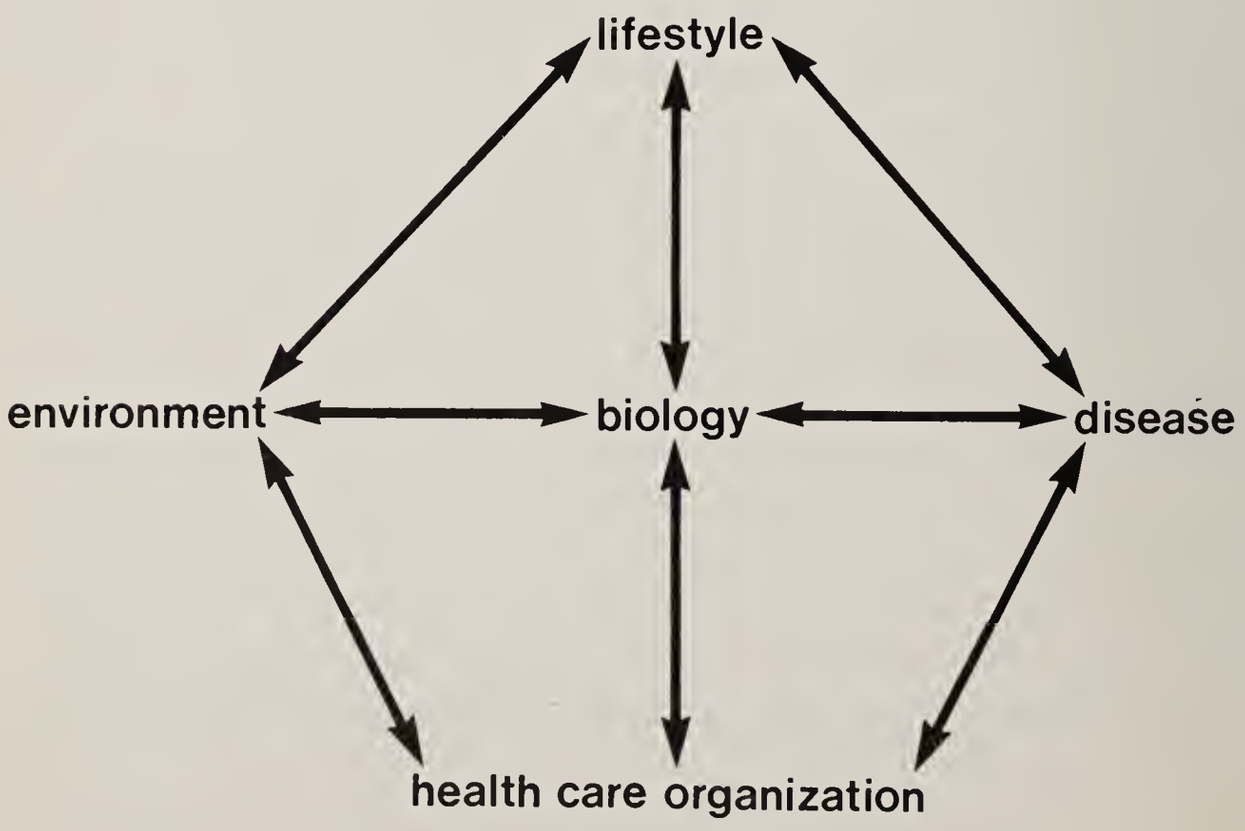


Figure 3: An Integrative Model of Health and Health Care



In this model, we can see that environment acts not directly on disease, but through intermediaries of lifestyle, biology, and health care organization. As an example, a polluted atmosphere may reduce physical activity (lifestyle), irritate the lung (biology), and be limited by a Board of Health stop-order (health care organization). Only in rare instances would the environment act directly, without an intermediary, upon disease, and vice versa. If the model has any utility, it may be in attempting to decide, for any particular disease, the points of optimal intervention. In most diseases, our experience would indicate that preventive modification of the biology through health care organization has done more than a direct attack upon the disease. As an example, immunization has virtually eliminated poliomyelitis in North America, while medical and surgical care has done almost nothing for cancer mortality. Some types of intervention may have beneficial effects on a number of diseases. For instance, a cleaner atmosphere might promote a healthier lifestyle, and reduce the biological effects due to inhalation of noxious agents. We might then expect a decrease in lung cancer, cardiovascular, and chronic respiratory mortality.

Although much is currently written about the need to improve health care delivery, there is little prospect that it will diminish either the incidence or prevalence of disease. Rather, through the vehicle of iatrogenic disease, there is a strong possibility that the health care system will exert a negative influence on the health of society: we must always examine the effect of health care through a two-tailed rather than a single-tailed statistical test. We must also consider the presence of disease in a population as having a considerable effect on the biology, lifestyle, and health care organization of that population. And especially in contagious disease, the existence of a disease at any point makes future occurrence of the disease more likely. Thus, disease influences disease. Neither in examining disease pattern can we neglect the question of competing risk. For example, the rate of endometrial cancer has been relatively static for many years. At the same time, hysterectomy rates have risen and left few

uteri at risk of developing the disease. So, if the number of cases in population is remaining static, while the number of persons actually at risk is diminishing, it may be that the attack rate among intact uteri is increasing. There has been some speculation that this possible increase would be due to action of estrogenic hormones (Ziel and Finkle, 1975; Smith et al., 1975). Should this be true, the estrogenic hormone is competing with the surgeon in attacking the uterus as a target organ.

I suggest that the model proposed in Figure 3 be used by persons proposing new methods of disease control, whether based upon environmental modification, immunization, or early detection. In using the model, the criteria for preventive effectiveness (Chapter 3) must also be considered.

Chapter 5

Specific Diseases* and their Preventive Measures

I INFECTIVE AND PARASITIC DISEASES

Intestinal Infectious Disease (Rubrics 000-009) includes diseases such as cholera, typhoid, and food poisoning. These diseases are not a severe health problem in Ontario, due primarily to our excellent sanitary facilities and our generally pure water supplies. Naturally, there are occasional problems, such as in times of disaster, breakdown of sanitary facilities, or introduction of contaminants into foodstuffs. Since public health legislation with its enforcement is effective for primary prevention, there is little prevention left for the health care sector. Immunization against cholera, typhoid, or paratyphoid is not recommended routinely for Ontario residents. For those individuals travelling outside the country, there may be more precautions taken. There is always the possibility that amoebiasis, protozoan disease, and other parasitic infections may be imported to this country by either travellers or immigrants. There is some feeling that immigrant populations, especially children, should be more carefully surveyed to ascertain the actual prevalence of such pathogens.

Control of Tuberculosis (010-019) depends on vigorous treatment, prophylaxis, and case finding. Although once a major public health problem, the relatively low incidence and the availability of effective therapy makes this a diminishing health hazard, except in high risk groups, such as Indians, Eskimos, immigrants, the poor, and certain persons with other chronic diseases. Tuberculosis is also an occupational hazard of hard-rock miners and zoo employees. Professions engaged in tuberculosis control, aware of the declining incidence and the consequent diminished effectiveness of mass screening have

* As listed in the International Classification of Disease (World Health Organization, 1967)

abandoned the routine chest x-ray survey and replaced it with tuberculin testing of certain age and risk groups. This is coupled with prophylactic treatment of persons who convert from a negative to a positive tuberculin reaction. Better surveillance among high risk groups such as health professionals and zoo employees is still needed; the former group is notorious for poor compliance with surveillance routines. No justification exists for the routine immunization, with BCG, of large segments of the Ontario population. Because such an immunization destroys the usefulness of the tuberculin test, x-ray exposure must be increased in order to keep an immunized population under surveillance. Since risks in all segments of society are relatively low, the disadvantages of losing the surveillance technique probably outweigh the advantages of the immunization afforded, except possibly in health professionals where BCG may be indicated. Current public health practice involves vigorous investigation of all new cases or converters. Such a program frequently discovers other converters or cases, including an "open" case presumably responsible for the infection of the index person. This contact tracing appears to be more cost-effective than traditional surveys.

Zoonotic Bacterial Diseases (020-027) include plague, tularemia, and anthrax, which are not major problems in the Ontario population, although there are certain individuals who may, because of hobby or occupation, demand greater surveillance and/or protection. No routine programs are suggested.

Other Bacterial Diseases (030-039) include leprosy, diphtheria, whooping cough, and a few other common human pathogens. There is ample evidence that diphtheria can become a problem if population immunization levels fall. Although school immunization programs are highly effective, there still remains the problem of immigrants and immigrant children arriving without adequate previous immunization. Immigrants should be screened at entry for immunization status and immunizations updated as appropriate. Meningococcal infection is not a serious public health hazard in most areas of the population, although it has been a recurrent problem on some Indian reserves. At present, field trials of meningococcal vaccine are

being carried on in Brazil by the U.S. Center for Disease Control. Such immunization programs have proven effective among U.S. army recruits (Gold and Artenstein, 1971). There may be some specific groups in Ontario that might benefit from such a vaccine if the Brazilian trials prove effective. Tetanus is not a major public health problem, especially since a very high percentage of the population has received active immunization at some time. Tetanus immune globulin (human) or tetanus antitoxin (bovine or equine) are occasionally needed for passive immunization. Prevention by prior active immunization is far preferable.

Poliomyelitis and Other Enterovirus Diseases of the Central Nervous System (040-046) include such well-known entities as poliomyelitis and aseptic meningitis. Poliomyelitis is now no longer a major public health problem, providing immunity levels are maintained. Control by immunization programs has proven to be highly effective although public and professional apathy reflects itself in poor participation. While Ontario uses a killed vaccine not generally thought to give as much protection as the oral live vaccine, the immunity conferred is still sufficient to keep the Ontario rates very low indeed. Poliomyelitis vaccine represents a public health program well-evaluated by large scale clinical trials to confirm effectiveness. For most other central nervous system enteroviruses, there is little prevention available.

Viral Diseases Accompanied by Exanthem (050-057) includes smallpox, chickenpox, herpes, and rubella, among others. Effective vaccines are available for measles, rubella, and smallpox. Public health immunization programs are extremely important for measles and rubella, not because of the direct effects of the diseases, but of the complications and sequelae. Currently, both measles and rubella vaccine are recommended for children. All pregnant women who may have missed rubella earlier in life should be tested for rubella immunization status during pregnancy; confirmed infection during pregnancy is considered an acceptable indication for a therapeutic abortion. Smallpox vaccination is not universally recommended because of the extremely small risk to Canadians not travelling to endemic

areas. Thus, the risk of adverse or even fatal reactions to vaccination far exceeds the risk of developing the disease. If total eradication of smallpox proves to be successful, this policy will be further reinforced. If smallpox is not eradicated, a well-developed public health system could still respond very quickly to any importation of smallpox, so that there would be no widespread epidemic.

Arthropod-borne Viral Diseases (060-068) include such familiar entities as yellow fever and mosquito-borne encephalitis. Only the encephalitides are important in Canada and for them no immunization is available. Control depends upon extermination of the mosquitoes capable of transmitting the virus from infected horses and other animals. There is enormous controversy over the role of spraying in mosquito control; spraying is not considered to be a health program, but one administered for health reasons. In this instance, the ecological damage may outweigh the highly questionable benefits of a program which fails to touch many of the common breeding places (eaves, small puddles) while concentrating on a few but more public water bodies.

Other Viral Diseases (070-079) include such common agents as infectious hepatitis, rabies, mumps, and infectious mononucleosis. Hepatitis, type B (post-immunization or post-transfusion hepatitis) is not included in this category, nor is Leptospiral jaundice, category 070. Infectious hepatitis (type A) is primarily a problem of fecal contamination of foodstuffs or water supply and is managed by adequate sanitation. Rabies is a particular problem in Ontario, since the disease is endemic among wild mammals. Although I would not recommend that the entire population be immunized, I suggest there is good reason to actively immunize high risk workers such as game officers and zoo workers, and eventually farmers. Such an immunization program must be monitored by a measurement of antibody titers. While the efficacy of the vaccine is not yet totally proven, it appears worthwhile and free of major complications. Mumps vaccine is recommended by the Canadian Paediatrics Society's Committee on Infectious Disease and Immunization, but not by the Ministry of Health. It is

available in a combination measles, mumps, rubella preparation. The mumps component would prevent meningitis, meningo-encephalitis, and pancreatitis which occur as complications. Control of psittacosis (073) depends primarily on strict quarantine and control of imported birds. For other viral diseases of this group, there are no specific preventive measures recommended.

The Rickettsioses and Other Arthropod-borne Diseases (080-089) includes such entities as typhus, Rocky Mountain spotted fever, and malaria. None of these are serious public health problems in Canada, although sporadic cases of Rocky Mountain spotted fever have occurred in Alberta and British Columbia; travellers or immigrants may import other problems. Specific control programs are not recommended or apparently needed.

Syphilis and Other Venereal Diseases (090-099) are most controversial in terms of control, less so in terms of treatment. Traditionally, venereal disease control has relied upon tracing of sexual contacts of known cases of venereal disease. Such tracing has usually been done by public health authorities who are frequently responsible for treatment. In instances where the public health authorities do not themselves operate venereal disease clinics, Public Health Nurses and physicians usually work very closely with such clinics to facilitate contact tracing. Tracing is a laborious procedure, dependent for success upon a number of factors including the diligence of the person who interviews the case, the honesty and personal position of the patient, and the correct identity and geographical location of the contacts. The problem is further compounded by the fact that a high percentage of persons with acute venereal disease seek and receive treatment from private practitioners who do not always report such cases for epi-demiologic follow-up. There is considerable doubt that the tracing process diminishes venereal disease rates (Blount, 1972). It may even reduce venereal disease reporting since many patients may try to avoid the investigation involved with such a policy. Certain persons may not appear for treatment out of fear of exposing themselves and friends to questioning.

Mass screening for venereal disease is of limited effectiveness, especially in the general population. Among high risk groups, however, such screening may have a role. High risk groups include homosexuals and prostitutes. Screening of pregnant women for syphilis is highly recommended, because although yield is low, the sequelae of congenital syphilis are so severe as to justify a large scale preventive program to detect and prevent such disasters.

Screening for syphilis is important in operation of a transfusion service, for the protection of the recipient. It is not productive in premarital, pre-employment, or other routine examinations. Because syphilis is predominantly a disease of the homosexual population (British Cooperative Clinical Group, 1973), control efforts are appropriately directed to that population. Education concerning risks and recognition is particularly important since a syphilitic infection may cause permanent and severe damage. There may be reason to recommend annual serologic examination for syphilis in homosexual males, especially those with multiple current partners.

Routine screening for gonorrhea is not a simple matter. Traditionally, we have concentrated on the asymptomatic female who may infect a large number of male partners. It was previously thought that gonorrhea in the male was almost uniformly symptomatic and, therefore, asymptomatic male carriers were not an important reservoir for the disease. More recent work now indicates that the asymptomatic male is not uncommon (Handsfield et al., 1974). To identify him, however, means inserting a wire loop or brush a considerable length into the urethra - a painful process, difficult to repeat in any kind of non-captive population. Unlike syphilis, the long term sequelae of treated gonorrhea are not usually severe. The occasional male stricture or female salpingitis and infertility threaten few lives. It may be argued, then, that gonorrhea should not be separated out from the other minor infectious diseases in medicine, but should be left to the usual methods of the private physician. There is, as yet, no effective immunization against either syphilis or gonorrhea nor are any such agents likely to appear, since we have ample evidence that previous infection

offers absolutely no protection for the future. Instillation of silver nitrate or penicillin drops into the eyes of the newborn is a proven, almost totally effective preventive measure for the gonococcal infection ophthalmia neonatorum, a cause of blindness.

In view of the controversies surrounding the effectiveness of venereal disease programs, it would appear appropriate to review this entire area with regard to public health policy. There might even be a case made for a clinical trial, in a specified geographical area, of abandoning current venereal disease follow-up methods in favor of advice to, "Have your partners treated", to measure the subsequent venereal disease experience in that area, compared to areas maintaining casefinding. Such a trial appears feasible, ethical, and worthwhile.

Other Spirochetal Diseases (100-104) are not public health problems, except for the occasional outbreak of leptospirosis in sewer workers or other persons occupationally exposed.

The Mycoses (110-117) are not uncommon problems in medical practice, although the opportunities for prevention are not remarkable. Dermatophytosis (e.g. athlete's foot and ringworm) is extremely common and some attempts are made to prevent this by measures such as footbaths in athletic facilities. Moniliasis (thrush) is a common infection among certain groups of the population, especially diabetics and women taking oral contraceptives. There is no specific preventive measure, except personal sanitation. The other mycoses are not particularly common, but important when they occur. No preventive programs are available for these.

Helminthiases (120-129) include the worm infections. These are not a major health problem in Canada, but isolated outbreaks do occur. Especially important from the standpoint of public health are hydatid, trichinosis, and other cestode infections, all caused by eating improperly cooked and infected meats. Meat inspection and adequate cooking solve most of the problems. Occasionally, some other parasites are picked up by children playing in dirt. The most common parasitic infection in

North America is Enterobiasis (pinworms) which is more an endemic nuisance than a health hazard. Preventive measures have not been shown to be particularly effective.

Other Infective and Parasitic Diseases (130-136) include some common and important infections. Toxoplasmosis, while probably a common infecting agent, causes few cases of actual disease or sequelae of infection. No specific preventive measures are advocated. Trichomoniasis Urogenitalis is a common vaginal infection which may be transmitted venereally. There are no specific preventive measures. Lice and scabies are also common public health problems, but lacking in specific preventives except general hygienic measures and pest control.

II NEOPLASMS

It has been estimated that from 80 to 95% of all malignant neoplasms occur as a result of environmental factors. Such a statement implies a broad definition of environment, to include personal habits such as smoking.

It is also generally realized that host factors are extremely important in the modification of environmental effects. The reader is referred to Chapter 4 for the earlier discussion of causation and prevention. Until recently, cancer research has emphasized cellular biology to examine the mechanisms by which a "normal" cell changes into a malignant one. Unfortunately, this type of research has given few, if any, clues as to environmental, host, or agent factors which might be modified for cancer prevention.

In the field of cancer prevention, attention has focussed upon early detection and treatment, rather than primary prevention. One of the few areas of extensive activity in primary prevention, the cessation of smoking, has not met with marked success.

There is ample evidence that exposure to more than one of the carcinogens will increase risk, not only by the additional exposure, but by interaction effects. For example, radon gas and cigarette smoking produce far more lung cancer than either

of these carcinogens acting alone, or with an additive effect (Archer et al., 1973). Asbestos and cigarette smoking have a similar interaction (Selikoff and Hammond, 1968; Shettigara and Morgan, 1975; Morgan and Shettigara, 1976).

Malignant Neoplasms of Buccal Cavity and Pharynx (140-149) include cancers of the lip, tongue, salivary glands, gums, and mouth. Almost all of these tumors are related to alcohol intake and smoking habits; most would be prevented by avoidance of smoking. Unlike most smoking-related cancers, risk here is not confined to cigarettes; pipe smokers are also prone to cancers of the lip, tongue, and mouth. Cancer of the lip occurs more commonly in fishermen, probably due to environmental exposure (Spitzer et al., 1975). Attempts at prevention of these tumors include cessation of smoking, regular examination by buccal cytology, and removal of pre-malignant lesions of lip and buccal mucosa. While removal of pre-malignant lesions (leukoplakia) is probably effective, its effect on mortality rates has not been measured. Screening programs for abnormal oral cytology have had very low yields and no demonstrable impact on cancer mortality rates. It appears that cytology may be a diagnostic tool for suspicious lesions rather than a screening device.

Malignant Neoplasms of Digestive Organs and Peritoneum (150-159) is a classification containing a number of interesting and perhaps preventable tumors. Malignant neoplasm of the esophagus has shown marked geographic variation, suggesting an environmental factor, as yet unknown, in the production of the disease. Smoking and alcohol have also been implicated and cessation would probably effect a certain amount of prevention. Malignant neoplasm of the stomach is a vanishing disease in North America, although no one has produced a strong hypothesis to explain its relative disappearance. It is more common among persons of Type A blood and in persons with pernicious anemia, although the mechanism of its development is unclear. Currently, prevention is minimal and concentrates on examining pernicious anemia patients for any possible malignant change from their usual atrophic gastritis. There are no strong indications for nutritional modification as a preventive measure.

Carcinoma of the large intestine is one of the most common neoplasms in the western world. Numerous etiologic theories have been, to a large part, unsubstantiated by real data. Recently, however, there has been some support for the relationship of a bulk or fiber deficiency in the diet to the occurrence of bowel cancer (Burkitt, 1973; Burkitt et al., 1974). Until further information is available, there are no grounds on which to suggest dietary modification. Early detection of this disease has been disappointing. Four approaches have been tried: digital rectal examination, sigmoidoscopy, x-ray examination, and biochemical screening (CEA test). Regular digital and sigmoidoscopic examinations, although unpopular with both practitioner and patient, might have some potential. They have not, however, been evaluated in a rigorous fashion to ascertain whether or not they will save lives. An x-ray examination involves too much potentially hazardous radiation exposure to be considered for routine use, and the CEA test is so insensitive and non-specific as to be useless as a screening test (Canadian Medical Association Journal 108, 1973). Early detection by stool examination for occult blood has been frequently suggested, but the suggestion has not been supported by data indicating such screening programs are effective in reducing morbidity or mortality. Furthermore, we cannot afford the luxury of a $20.00 procedure annually for every person over 40 years of age.

A rare disease, familial polyposis of the colon, is considered a pre-malignant condition. Cancers will occur in the multiple polyps of these people, if left. In this instance, primary prevention of colon cancer is accomplished by screening relatives of known polyposis patients, with colectomy following discovery of polyps. Similarly, ulcerative colitis may progress to malignancy. Medical treatment of the disease includes close observation for malignant change; surgical therapy (colectomy) usually prevents subsequent malignancy.

Malignant neoplasms of the liver are relatively uncommon, but have been linked to both alcohol and environmental exposure, especially to vinyl chloride monomer (Makk et al., 1976). Thus, although the tumor is relatively rare in the western world, it

is potentially preventable by a modification of lifestyle and by a cleaner workplace.

Carcinoma of the pancreas has been reported to be showing a slight increase in incidence over some period of time. Although the reason for this rise is not clear, it is thought not to be due to a reporting artifact. Once again, although alcohol is implicated, there may be other environmental factors, as yet undiscovered.

A relatively rare but uniformly fatal tumor, peritoneal mesothelioma, is almost invariably a result of previous asbestos exposure. Avoidance of asbestos fiber exposure will effect primary prevention. Secondary prevention is ineffectual.

Malignant Neoplasms of Respiratory System (160-163) include both common and uncommon tumors. There is an excess of nasal and sinus cancer among workers exposed to sawdust, nickel, and chromium (Mosbech and Acheson, 1971; Mastromatteo, 1967; Cole and Goldman, 1975), although the disease is not common. Carcinoma of the larynx is more common and usually found among smokers. It has, however, also been associated with asbestos exposure and geographically follows the same incidence pattern as does carcinoma of the lung, indicating that industrial causation is probably more important than previously realized (Stell and McGill, 1973; Shettigara and Morgan, 1975; Morgan, 1976). More research is needed to identify the specific carcinogens but an improvement in environmental sanitation would probably lead to a reduction of incidence. It is sobering to consider that environmental and occupational standards for asbestos and arsenic emissions and exposures are set, not on carcinogenic potential, but on the basis of prevention of asbestosis or arsenic poisoning.

Malignant neoplasms of trachea, bronchus, and lung are due, to a large extent, to cigarette smoking. As well as smoking, at least fifteen other factors are implicated, including exposure to asbestos, arsenicals, and various chemical agents. Although the relationship of smoking to lung cancer has now been known for more than 25 years, health authorities and the medical profession have not been markedly successful in diminishing smoking habits. Only a few occupational groups,

notably physicians, have greatly reduced their smoking habits. It is encouraging that in the last few years, male smoking throughout the population has diminished (Health and Welfare Canada, 1976).

For women, however, the news is not so good. Women took up cigarette smoking as a habit some 20 years after their male counterparts: their mortality curves for smoking diseases have since followed the male pattern, albeit 20 years later. In terms of behavior, rates of males stopping or never starting smoking are static or showing a slight improvement. However, women aged 15 to 25 are starting to smoke at a greater rate than ever before (Hanley and Robinson, 1976). This will certainly cause substantial later mortality and morbidity from both neoplasms and cardiovascular disease. Governments at all levels have been slow to act in restricting advertising, sales, or consumption of cigarettes. Indeed, in some years tobacco farmers actually receive federal subsidies. While politicians generally have been reluctant to take positive action against smoking, many medical practitioners have been enthusiastic in their attempts to convert individual patients. Unfortunately, physician enthusiasm does not always infect the patient. There seems to be, at best, about a 40% "cure rate" for physicians dealing with people who indicate a strong desire to quit. Among those with little or no desire, the success rate is even less.

The best long-term solution to the smoking problem is to make the habit socially unacceptable. Smokers, who are now a minority, should be segregated for this activity. Currently, the non-smoker has few places of refuge from the smoker, and such places are frequently inferior to those enjoyed by his smoking counterpart. We must move from a practice of smoking being permitted except where forbidden to a standard which says smoking is forbidden unless otherwise posted.

If smoking is difficult or impossible to control, can we render it less harmful? Cigarette technology has reduced inhaled tar levels considerably; there is some evidence that this has a positive health effect (Wald, 1976). Filters remove tar, the probable carcinogenic agent. They do not remove carbon monoxide, a psychomotor and cardiovascular hazard, or

necessarily remove other unknown agents in cigarette smoke that predispose smokers to coronary artery disease, stroke, and peripheral vascular disease. Thus, the search for a non-carcinogenic tobacco or "safe" cigarette will likely succeed only in diminishing some cancer incidence; the other diseases of smoking may remain.

In recent years, there has been a considerable amount of interest in the health effects of "passive smoking" - the inhalation, by a non-smoker, of the fumes from nearby burning cigarettes, cigars, and pipes. It has not been possible to quantitate this particular danger. This is not surprising, in view of the multiple carcinogens to which we are exposed and the long length of time involved in production of the cancer after exposure. Passive smoking might account for some of the non-smokers who develop lung cancer. In view of the fact that the smoke is known to be carcinogenic, we should protect, wherever possible, the non-smoker from the effects of cigarette smoking. The suggestions made in previous paragraphs concerning public policy cannot be countered with the argument that we have not yet proved the health effect of passive smoking. Surely the onus of proof must lie with the manufacturers of tobacco products to prove their product safe.

Special attention should be given to the risk of cancer among persons with occupational exposure to carcinogens. We have ample evidence that exposure to radon gas or asbestos potentiates the carcinogenic effect of cigarette smoking. These people should be given special attention to attempt to reduce or eliminate their smoking habits. Such attention would include prohibition of smoking at the workplace, educational programs, and family oriented programs.

The dramatic relationship of smoking to lung cancer may have impeded the search for other factors. While we slowly proceed to identify gross environmental factors from the workplace, we continue exposing the general populations to volumes of materials known or suspected as carcinogens. Our epidemiologic or other techniques are unable to measure the health effect of small to moderate exposure to mixtures of substances over the many years needed to produce cancers,

especially respiratory. We cannot consider lung cancer a "solved" disease reflecting individual habit and irresponsibility. If smoking disappears, lung cancer will not. Neither can we neglect host factors such as $alpha_1$-antitrypsin deficiency, a risk factor for lung cancer (Harris et al., 1974). Should people with this genetic predisposition be denied employment in asbestos or chemical industries?

Malignant neoplasm of the pleura is usually synonymous with mesothelioma (Selikoff et al., 1965; Newhouse and Thompson, 1965; McDonald et al., 1970), a disease traceable in almost every instance to asbestos exposure. This uniformly fatal disease occurs some 15 to 35 years after exposure and does not appear to be related to the dosage of asbestos received. Although relatively rare, it is an awesome reminder of the carcinogenic potential of asbestos, even in small quantities.

I.C.D. Categories (170-174) include Malignant Neoplasms of Bone, Connective Tissue, Skin, and Breast. Neoplasms of bone are relatively rare and are not considered preventable, except by avoidance of excess radiation exposure. Malignant melanoma of the skin, however, is more common and may be preventable. It has been strongly linked in recent years to exposure to sunlight, causing one to seriously question the cult of acquiring and maintaining a suntan. Squamous and basal cell carcinomas of the skin, while somewhat less lethal than melanoma, are much more common, with a corresponding demand on health care services. These neoplasms are also related to ultraviolet exposure and therefore potentially preventable. There is some evidence that chronic exposure to arsenicals will also predispose to cutaneous malignancy. There have been few, if any, educational programs directed towards outside workers or outdoor enthusiasts. The intent of such programs would not be to move people inside but rather to educate them to methods of self-protection. A potential hazard, as yet unstudied, exists for patients with other chronic skin diseases, especially psoriasis. They are smeared and shampooed with tar (a known carcinogen), and irradiated with light (another carcinogen). The long term effects of this on skin and bladder cancer should be investigated.

Carcinoma of the Breast (174) is the commonest cause of female cancer mortality. About 1 woman in 16 will eventually develop the disease; more than half of those affected will ultimately die of it. The etiology is complex but closely related to reproductive events (Vakil and Morgan, 1973A; Vakil and Morgan, 1973B; Morgan and Vakil, 1974). Women with a family history of premenopausal and/or bilateral cancer have 8-20 times greater risk than women without that family history. An early age of first pregnancy exerts a considerable protective effect, with women who deliver their first child at age 15 having approximately one-third the risk of those who wait until age 30. Currently, primary prevention is difficult to attain except by earlier childbearing, and in occasional instances, prophylactic simple mastectomy. Since irradiation with x-rays also increases breast cancer risk (Myrden and Hiltz, 1969), the number and dosage should be minimized.

Secondary prevention may be practical, especially in women age 50 to 65 (Strax et al., 1973; Shapiro et al., 1972). Annual examination of the breasts by a physician and x-ray can find tumors earlier, with a subsequent reduction in mortality. Unfortunately, the same has not been proven effective for younger women who have potentially many more years to be gained through better survival. Our attempts to effect early detection of breast cancer have not, to the present time, included a rigorous trial of breast self-examination, nor an appraisal of thermography, both non-invasive techniques for early detection. Most of our screening programs have been limited to cross-sectional surveys, rather than longitudinal programs of re-examination, which might prove more effective, especially for thermography. There is considerable evidence that more work remains to be done. A further discussion of breast cancer screening appears in Chapter 7.

Carcinoma of the male breast, while not a common disease, has certain preventable aspects. The disease is commoner among transvestites and other men who use estrogen for various purposes. The large amount of estrogen consumed by such persons appears capable of causing a malignant change in their breasts. Physicians treating such individuals or prescribing estrogens to

men must be aware of the dangers involved.

There is considerable uncertainty concerning the role of oral contraceptives and other exogenous estrogens in the production of breast cancer. While there is evidence that oral contraceptives diminish the incidence of benign breast disease, there is, as yet, no good evidence concerning the role of oral contraceptives and breast cancer. Such evidence is probably at least ten years away, since one would anticipate that if oral contraceptives increase or decrease breast cancer, they would do so in women first exposed to the pill before the age of 20. Since breast cancer does not occur with great frequency until after age 40, we do not yet have a group of women who have gone through the expected lead time.

Carcinoma of the Uterine Cervix (180) is a disease of enormous controversy. Though not a frequent cause of death, it is still an important cause of morbidity and mortality. It usually strikes women of lower socioeconomic status and has been directly related to both early age of first intercourse and the number of sexual partners (Rotkin, 1967; Kessler, 1974). These characteristics have led some people to suggest that it is a venereal disease, possibly of viral origin. Controversy surrounding the prevention of carcinoma of the cervix centers on the efficacy of the Papanicolaou smear, developed in the 1940's. The smear has been used to detect a pre-invasive stage of cancer (carcinoma in situ) theoretically amenable to cure in all instances. It is generally considered that all cases of invasive carcinoma have, at some time, passed through an in situ phase. There is, however, far more in situ disease than invasive so the possibility of either a stationary stage of in situ or a regression to normal has been proposed. This would mean that more women would be treated for in situ disease than would be expected to go on to frank invasive disease. To further complicate matters, the incidence of and mortality from invasive carcinoma of the cervix has been falling steadily, even in places where no smear programs existed (Ahluwalia and Doll, 1968; Sellers and McLerie, 1973). In some instances, this natural decline may have been falsely attributed to effectiveness of the smear campaign. Unfortunately, the women

who attend annually for the Pap smear are frequently of the upper socioeconomic strata, have begun sexual activity after the age of 16, and have had few, if any, sexual partners. The women who develop the disease are exactly the opposite. Since the campaign is most popular with women who do not get the disease, most of the cancer occurs in women who have never had a Pap smear. It is estimated that a period of 10-20 years is usually necessary for progression of carcinoma *in situ* to micro-invasive disease. This long latent period is advantageous for screening, since it means the disease can easily be found before becoming invasive. For the general female population, annual screening is a waste of resources since for most women little would be lost by screening every 3-5 years. Some exceptions should probably be made for high risk women, especially those who have ever shown any evidence of dysplasia. These women have a much higher risk of disease and should probably be screened annually. It is also recommended, for all women, that the first two screenings be one year apart, since the 10% error rate in interpreting smears could lead to serious problems if the first smear was not validated. We are unlikely to ever know the effectiveness of the Papanicolaou smear. It has become accepted medical practice without large scale controlled clinical trials. Because of that situation, I concur with the recommendation that the test be available to all, but with increased attention to high risk women and with guidelines to control wasteful over-use of resources (The Walton Report, 1976). The almost uncontrolled growth of cervical cytology screening programs in the absence of demonstrable effectiveness provides a clear object lesson in the need to evaluate new procedures, however "innocuous", before allowing them to lodge in medical practice.

Of the other gynecologic malignancies, carcinoma of the corpus uteri is the most important. Recently this disease has been linked to administration of estrogens (Ziel and Finkle, 1975; Smith et al., 1975). Previously known risk factors included obesity, hypertension, and diabetes. Although the epidemiologic studies implicating estrogens are not without weaknesses, the association is probably real. This means that hundreds of thousands of women have received a carcinogenic drug

for treatment of menopausal symptoms. Although there was ample theoretical reason to suspect the drug as a carcinogen, there was no long term surveillance of populations receiving this medication to detect any untoward effects. Since animal testing of such drugs can never duplicate the human experience, it was probably necessary to put drugs into human use without total knowledge of their eventual effects. It would seem, however, that any such use should be accompanied by intensive long-term surveillance of those people.

Stilbestrol is another unfortunate example of iatrogenic carcinogenesis. A number of women from age 10 to 25 have not developed carcinoma of the cervix and/or vagina. As well as the disease, many of the women have one thing in common: their mothers were given Stilbestrol while pregnant with the affected daughters (Herbst et al., 1971). This episode represents the first reported association of in utero exposure to a drug with cancer many years later. Without doubt, other examples must occur but have not yet been documented. The drug in question was given for threatened abortions and was always of questionable usefulness and unknown long-term effects.

Other malignant neoplasms of the female genital organs are uncommon and are not easily amenable to prevention, with the possible exception of carcinoma of the vulva, which may be preceded by leukoplakia. Such leukoplakia, if recognized by the physician, can be excised before malignant change occurs. The low frequency of disease does not warrant any large scale screening program to attempt to detect leukoplakia, although public education might speed detection. It is dubious, however, if most elderly women could be persuaded to examine their vulvae with a mirror.

Carcinoma of the Prostate (185) is probably the commonest male carcinoma, after skin cancer. It is a disease of older age and a frequent incidental finding at autopsy. Etiologically, it has been related to both air pollution (Winkelstein and Kantor, 1969) and to industrial cadmium exposure (Buell, 1975), although both of these relationships are controversial. Routine rectal examinations have been promoted as a means of detecting early disease; the effectiveness of such examinations in improving

survival has not been demonstrated.

Other neoplasms of the male genitalia are uncommon and not easily preventable except possibly for carcinoma of the glans, which has been related to poor hygiene. It has been suggested that circumcision would protect against this disease; it is likely that proper washing would prove as effective.

Recently, self-testicular examination (STE) has been advocated to detect testicular tumors. While the rationale is similar to that of the female breast self-examination (BSE), testicular tumors are much rarer. There is no evidence that early detection improves survival.

Carcinoma of the Urinary Bladder (188) is a classic example of environmental carcinogenesis. This disease was first linked to the aniline dye industry. Subsequent investigators have also related it to industrial gas production, rubber manufacture, and shoe tanning (Cole et al., 1972; Case, 1966; Hueper, 1969). Smoking is a potent etiologic factor with or without occupational exposure. Because so many potentially carcinogenic substances are passed through the bladder, it is likely that further environmental carcinogens for this organ will be identified. Primary prevention depends upon avoidance of smoking and industrial exposure. There have been a number of programs for secondary prevention by urinary cytology in high risk workers. While this may identify the disease at an earlier, pre-clinical stage, there is no evidence at the moment that there is a significant gain in survival through early detection and treatment. Thus the prime importance of the screening program is to identify workers for compensation purposes. Primary prevention depends upon vigorous industrial health programs, currently lacking in most areas.

Other malignancies of the urinary tract are of relatively less importance or have no prevention possibilities at this time.

Malignant Neoplasms of Other and Unspecified Sites (190-199) include a number of diseases, some of which are preventable. Some malignant tumors of the brain have been related to exposure to vinyl chloride monomer; in the future other carcinogens will be similarly identified. Malignant

neoplasm of the thyroid gland has been related to previous medical irradiation (Becker et al., 1975; DeGroot and Polan, 1973) - another example of iatrogenic carcinogenesis. Prevention of these malignancies means avoidance of the exposure. Early detection appears to be of little benefit.

Neoplasms of Lymphatic and Hematopoetic tissue (200-209) include the lymphomas and leukemias. Although there has been a large amount written concerning the possible infective nature of Hodgkin's Disease (Vianna and Polan, 1973), there is still no definitive proof and no recommendations for prevention of its spread. Tonsillectomy in childhood may increase the later risk of developing this disease; this adds further weight to the argument against routine tonsillectomy. Both lymphomas and leukemias have been related to excessive exposure to ionizing radiation, either through war, accident, or medical therapy. Once again, primary prevention depends on avoidance of exposure. Secondary prevention by early detection and treatment for lymphomas and leukemia is not generally recommended.

Benign Neoplasms (210-228) include a wide variety of non-malignant tumors, most of which have little implication for prevention. They usually produce medical effects by pressure, blockage, or hemorrhage and most are easily removed.

Neoplasms of Unspecified Nature (230-239) is a category designed for use in those many instances where sufficient information is not supplied to indicate whether the tumour is benign or malignant. The same category includes, however, carcinoma <u>in situ</u> of the uterine cervix, an entity previously discussed under the rubric of carcinoma of the cervix. The inclusion of it in this section of neoplasms indicates the uncertainty that exists concerning whether or not it is a true malignancy. Except for carcinoma of the cervix, none of the diseases listed in this section has important preventive implications.

III ENDOCRINE, NUTRITIONAL AND METABOLIC DISEASES

Diseases of the Thyroid Gland (240-246) are important to consider from the standpoint of public health. Simple goiter

(240) is almost entirely prevented by the addition of iodine to our salt. We do not know the mechanism by which iodine prevents this goitre, although theories abound; there is ample evidence that iodized salt is an effective preventative. Prevention of goiter by iodine illustrates that we need understand neither disease cause nor mechanism of prevention to accomplish eradication.

Congenital Cretinism (243) is a disease of poorly understood etiology but of considerable importance since early recognition will prevent the mental retardation which is inevitable if the condition is left untreated. Generally, obstetricians, pediatricians, and family practitioners are sufficiently aware of the disease that a special program is not needed.

Diseases of Other Endocrine Glands (250-258) include diabetes mellitus and a number of less frequent endocrine problems. Although the rubric (250) does not distinguish types of diabetes mellitus, it is important to realize that there are major differences between juvenile diabetes which occurs before age 20, and maturity onset diabetes which usually occurs after age 40. Juvenile diabetes is more severe and usually presents as a medical crisis. The maturity onset diabetes is frequently found in the course of a routine urinalysis or through investigation of some other problem such as infection. There is no preventive program suitable for juvenile diabetes, except perhaps genetic counselling. The preventive aspects of treatment, however, are important since the diabetic must learn to live with a permanent condition and the numerous potential problems concerning the skin and cardiovascular systems. The female diabetic has a particular set of obstetrical complications, with increased fetal wastage and frequent congenital malformations.

There is uncertainty concerning the role of primary prevention in maturity onset diabetes. Despite a lack of firm data, it can be argued that weight reduction or control is advisable in persons with a family history of diabetes. While this may not totally prevent the onset of disease, it may delay that onset and reduce the associated cardiovascular, renal, and ophthalmic complications.

Secondary prevention of diabetes mellitus through mass screening is controversial. There is no evidence that early treatment of maturity onset diabetes will prolong life or diminish the frequency of complications. It must be remembered that the elevated blood sugar is only one part of the generalized disturbance in metabolism due to diabetes, and control of that blood sugar does not reverse the other problems. Because of our uncertain success in treating asymptomatic maturity onset diabetics, I cannot recommend wide-scale screening programs to identify latent diabetics. We can offer these people nothing but anxiety and perhaps needless dietary restrictions with no probable benefit. For the person who has diabetes severe enough to give complications, there is, of course, a stronger rationale for treatment. Further research to evaluate early diagnosis and treatment should be a high priority.

Avitaminoses and Other Nutritional Deficiencies (260-269) are not a serious problem in Ontario. Clinical vitamin deficiencies are rarely seen, thanks to generally adequate nutritional supply and some selective vitamin supplementation of common foods. Where such deficiency exists, it is usually found among native populations, food faddists, or chronic alcoholics. All three groups have nutritional habits which may be less than optimal. There are also a few individuals suffering from malabsorption syndromes or other diseases which can lead to vitamin deficiency. There is a danger of food supplementation with vitamins because of the possibility of over-dosage of these substances. In such dosages, Vitamin A can lead to bone changes (Scrimshaw, 1971) and Vitamin D to mental deficiency (Committee on Nutrition, 1963). Although many people decry our current nutritional status, there is no evidence that widespread intake of vitamin preparations is warranted. The use of Vitamin C for cold prophylaxis is not recommended since it does not reduce the number of colds, but may diminish the symptoms (Anderson et al., 1972; Anderson et al., 1974). I suggest Vitamin C be considered a treatment, not a preventative.

Other Metabolic Diseases (270-279) include a wide variety of congenital metabolic disorders, most of them rare. The

hypervitaminoses are also included. Among the amino acid metabolism problems, phenylketonuria is probably the best known. There is almost uniform screening of newborns for this disease and relatively effective control, by diet, of the metabolic problem. Early versions of this test lacked both specificity and sensitivity and created some hazards for the child who was falsely diagnosed as having PKU. Now, however, more sophisticated laboratory investigation allows accurate identification after the screening test, which is only a presumptive identification of children who may have the disease. While diagnosis of other amino acid problems is possible, there is no screening on a routine basis for these. General disorders of carbohydrate metabolism are relatively rare and are not screened for specifically. The congenital disorders of lipid metabolism are relatively more frequent and of considerable public health importance as the hypercholesterolemia may lead to an increased incidence of coronary artery disease. There are currently clinical trials of treatment of these disorders which may give us more information as to whether or not we should actively screen for this abnormality. At the present time, however, I cannot recommend mass screening for disorders of lipid metabolism; selected screening for persons with positive family history may be indicated.

Other metabolic diseases in this category have little implication for prevention except for gout and obesity. A high proportion (perhaps 50%) of persons presenting for treatment with acute gouty arthritis have had their attack precipitated by treatment with diuretics, usually for essential hypertension (Healy and Hall, 1970). It is imperative that physicians using these drugs be aware of the possible side effects and educate their patients as to the possibility. Otherwise, the disease is either misdiagnosed or diagnosed correctly only after considerable delay and investigation.

Obesity not specified as endocrine is an extremely common health problem. It is highly probable, however, that the health effects of obesity have been seriously overrated. Although obesity is frequently associated with hypertension, coronary artery disease, and diabetes, it is by no means certain

that weight control will protect against or delay the onset of any of these diseases (Mann, 1974; Hatch, 1974). Prevention of obesity may be possible if instituted in childhood; later is too late. The adult must be protected against the effects of overtreatment of obesity, especially with dangerous and addicting drugs.

Many of the congenital metabolic disorders lead to consideration of genetic counselling. It is unfortunate that genetic counselling has not proven to be highly effective: compliance with advice given is estimated as between 10 and 65% (Beck et al., 1974; Carter et al., 1971). Problems involved in genetic counselling include:

1. Identification of parents or prospective parents at risk
2. Education of physicians for referral for counselling of such parents
3. Problems of educating the prospective parents
4. Difficulty in translating knowledge into practice and thereby changing behaviour.

Such questions have caused a number of people to question the cost-effectiveness of genetic counselling and wonder whether there is any way in which its success can be improved. It does not appear likely that there will be an easy solution to the translation of reproductive probabilities to reproductive behavior. Genetic consultation may be very useful, however, in indicating the need for amniocentesis in the pregnancy at high risk of metabolic defect.

Metabolic abnormalities (if not diseases) will increase in importance to prevention as we improve our understanding of host-agent-environment interactions to better appreciate how the body metabolic pathways manage (or fail to manage) various chemical insults. This may lead to prevention of some form of cancer by either modifying the host (genetic engineering) or avoiding, for that person, exposure to certain substances.

IV DISEASES OF BLOOD AND BLOOD-FORMING ORGANS

Diseases of the Blood and Blood-Forming Organs (280-289) include those blood disorders not previously mentioned among the

leukemias. The commonest and "most preventable" of these illnesses is Iron-Deficiency Anemia (280) which may be due to inadequate iron intake, blood loss, normal growth, or combination of the above. Typically, this is a disease of infants, young women, and aged persons with other diseases. Screening for iron deficiency anemia is not recommended, however, because of the low percentage of persons with severe anemia and the questionable benefits of raising people with a "borderline" hemoglobin up to a "normal" level (Elwood, 1974). There would appear to be few, if any, benefits from raising a hemoglobin of a comfortable and healthy young woman by one gram. The cost of the massive screening is not warranted.

Other Deficiency Anemias (281) reflect metabolic defect or nutritional deficiency. There is no justification for massive screening programs for these diseases, nor are any primary preventive methods important, since such severe nutritional deficiencies are almost unheard of in Western Society. It might be noted, however, that an enormous amount of Vitamin B-12 and B complex is given for "anemia" not related to such deficiency. A preventive approach would avoid over-medication with questionable agents where not indicated.

The Hereditary Hemolytic Anemias (282) include a large number of congenital problems. For these, primary prevention is through either genetic counselling, or in the case of glucose-6-phosphate dehydrogenase deficiency, avoidance of the particular chemicals (such as fava beans) which precipitate a crisis. Screening tests have been used for some of these diseases, but present the problem that their prime use is for genetic counselling which may be misinterpreted as racist genocide. The remaining Anemias (283-285) have no preventive overtones, except where aplastic anemia is secondary to previous use of drugs such as chloramphenicol. The occurrence of aplastic anemias after a number of drugs should reinforce the notion that medication should be used only where necessary and then only with care.

Coagulation defects, purpura, agranulocytosis, and other diseases of the blood and blood-forming organs are uncommon diseases with no implications for primary and secondary

prevention except occasionally for genetic counselling, especially for persons with coagulation defects. Secondary prevention by screening pre-operative patients for coagulation defects has not generally proven practical; the mainstay of our medical approach is treatment and rehabilitation of persons with these diseases.

V MENTAL DISORDERS

Mental Disorders (290-315) include a variety of forms of mental disorder, some of which are secondary to physical conditions. The Psychoses (290-299) include senile and pre-senile dementia, alcoholic psychoses, a number of psychoses associated with cerebral conditions, schizophrenia, and certain other psychotic states. In general, prevention of psychoses has not proven satisfactory although there is some evidence that senile or pre-senile dementia may be delayed by maintaining aging people in a stimulating environment with continuing communication. Alcoholic psychosis is naturally best prevented by avoidance of alcoholism, a disease where prevention has not been notably effective. For psychoses associated with intracranial infections and other cerebral conditions, prevention depends upon preventing the underlying problem. Schizophrenia has received a great deal of attention in terms of etiology but, as yet, there are no effective measures for primary or secondary prevention. Neither are there any known effective forms of prevention for the other psychotic states.

The Neuroses, Personality Disorders, and other Psychotic Mental Disorders (300-309) include a wide variety of illnesses ranging from anxiety neurosis through sexual deviation to drug dependence and psychosomatic illness. But there are no known effective forms of prevention except perhaps in the case of drug dependence where physicians have a particular responsibility for the prescribing habits.

Mental Retardation (310-315) relies on primary or secondary prevention of the underlying cause.

A few attempts have been made at secondary prevention of mental illness, although identification of such disease is most

inexact. In a clinical trial of psychometric testing followed by random psychiatric referral or non-referral of "abnormals", the untreated group fared almost as well as those referred, indicating that screening and early treatment are not effectual for mental disorders, especially over a long term (Johnstone and Goldberg, 1976).

For most mental illness, primary prevention is probably closely related to such variables as family stability, poverty, stress, and job satisfaction. Unfortunately, we lack strong evidence that manipulation of these variables will reduce illness. If such primary prevention is feasible, it will certainly not be delivered in the context of health care.

VI DISEASES OF THE NERVOUS SYSTEM AND SENSE ORGANS

Inflammatory Diseases of the Central Nervous System (320-324) include meningitis not classified as infective. It also includes phlebitis of venous sinuses, intracranial abscess and encephalitis. There are no methods of primary prevention available for either this type of meningitis or phlebitis or abscess. Likewise the encephalitis does not include the specific varieties previously classified as "infective disease". Therefore, no preventive measures are available or recommended.

Hereditary and Familial Diseases of the Nervous System (330-333) include a number of familial diseases, many of which are preventable by genetic counselling. In the case of Huntington's Chorea (331), an autosomal dominant gene, there may soon be a test to identify those persons who will develop the disease in later life. Since the test could be applied at puberty, sterilization of persons with a positive test would effect total primary prevention. Those with a negative test would have the reassurance of their future health and genetic capability. Obviously, the ethical issue of informing a 12-15 year old boy that at age 35 he will certainly be demented like his father must be resolved before application of such a test. For Tay-Sachs Disease (333) there is a test available which identifies the carriers of this recessive gene. Since the disease is almost solely confined to Ashkenazy Jews, the

population at risk is clear. In those instances where both partners are carriers, they may elect to have no children or to have amniocentesis for each pregnancy, with the option of aborting any affected fetus. Here then we have an example of primary prevention (avoidance of pregnancy) or secondary prevention (early detection and abortion) for the same disease. Currently, in Ontario, there is a voluntary Tay-Sachs screening program operated by the Hospital for Sick Children with the cooperation of the Jewish community. The province has not seen fit to support this as a provincial program; the reasons for lack of support are unclear and should be re-evaluated.

The Other Diseases of the Nervous System (340-358) include a wide variety of conditions, mostly not amenable to primary or secondary prevention. Paralysis Agitans (342) may be preventable when caused by drugs such as chlorpromazine. Other forms of the disease are not, at this moment, preventable. Some Cerebral Palsy (343) is preventable by good prenatal care and excellent medical attention at time of delivery.

Inflammatory Diseases of the Eye (360-369) include such common diseases as conjunctivitis and blepharitis. In none of these is prevention particularly important for disease control.

Other Diseases and Conditions of the Eye (370-379) include a number of important ophthalmic problems. Refractive errors affect probably 40% of the adult population. To date, there has been little work done on prevention although there are some tantalizing theoretical possibilities. Mass screening for refractive errors is not recommended since most people requiring optical correction will seek it. There is probably justification for routine screening of school children at school entry and yearly after age 10, since impaired acuity might adversely affect scholastic performance.

Strabismus (373) is a disease of considerable importance, since if untreated in childhood, the muscular imbalance may lead to amblyopia, a blindness in one eye. Usually the condition is easily diagnosed on routine physical examination but the problem must be corrected in the pre-school child, to preserve sight. The 3-5% of children with strabismus are detected through examination by physicians, orthoptists, or specially trained

nurses. While there is no formal screening program in most areas of Ontario for this condition, competent physicians are fully aware of the importance of examining children for this during routine childhood examination.

Glaucoma (375) is the most common cause of pensionable blindness in Canada, and affects about half of one percent of the population over age 40 (Morgan, 1972). There are a number of varieties of glaucoma, of which open-angle (primary) glaucoma is the commonest. Secondary prevention has centered around screening for increased intraocular pressure since about 80% of persons with open-angle glaucoma will show an elevated pressure. Probably less than 10% of persons with elevated pressure, however, exhibit visual field defects typical of glaucoma. This creates a dilemma since the treatment of elevated intraocular tension can in itself destroy vision. There is no evidence that treatment of ocular hypertension reduces the subsequent incidence of visual field defects. There is an urgent need for controlled clinical trials of the management of ocular hypertension to validate the generally held belief that such treatment is effectual. Screening for visual field defect to identify true cases of glaucoma has not been generally practiced although there is some evidence that it might be a practical method (Rock et al., 1973). Once again, should such screening be done, it would be necessary to prove that early diagnosis and effectual treatment provide an advantage over normal medical care practices.

There is some hope for limited primary prevention of glaucoma because of the evidence that people who undergo hypotensive episodes may be prone to develop glaucomatous-like field defects in the future (Drance et al., 1973; Morgan and Drance, 1975). This would mean that persons receiving treatment for systemic hypertension, as well as those having a drop in blood pressure due to surgical or medical emergency might be more prone to loss of vision. To date there has been no attention paid to examination of visual fields before and after treatment of systemic hypertension. This would appear to be a research priority of considerable urgency. Routine screening for glaucoma is not recommended at this time.

Other diseases of the eye are generally considered not easily preventable except for some infections classified under infective disease.

Diseases of the Ear and Mastoid Process (380-389) are common, primarily affecting young children. Otitis externa is not an important cause of morbidity and needs no specific preventive program. Otitis media, with or without mastoiditis, prevails among families of low income, Canadian Indians, and Inuit. The chronically draining ear with subsequent loss of hearing is an all-too-frequent occurrence in these populations and may affect over 50% of the children. Trials of prophylactic antibiotics have indicated that such treatment may be useful for these extremely high risk populations (Maynard et al., 1960). There should be some consideration given to further trials of antibiotics among other native groups.

The only other ear disease of public health importance is noise-induced hearing loss, which is important to prevent both at the primary and secondary levels. This means that there should be proper engineering for avoidance of high levels of noise, especially in the industrial environment. Where technology does not allow sufficient diminution of noise levels, adequate protective apparatus must be found. The worker exposed to such levels should be tested periodically to find the first changes indicative of noise-induced hearing loss and that person should then be given further protection or removed from the hazardous environment. Thus, a combination of primary and secondary preventive programs should effect a decreased incidence of noise-induced hearing loss. Those persons exposed occupationally to such levels are at an increased risk of developing problems from avocations, such as snowmobiling, shooting, and rock music (Alberti et al., 1976). For the vulnerable individual, it may be necessary to reduce this noise exposure.

VII DISEASES OF THE CIRCULATORY SYSTEM

Rheumatic Heart Disease, both active and chronic, is found in categories 390-398. Rheumatic fever and its sequelae

are due to previous infection with the beta-hemolytic streptococcus and ensuing body reaction. Prevention of this disease depends upon effective treatment of acute streptococcal infections (Gordis, 1973); prophylactic sulfonamides or penicillin for persons who have already undergone one episode of rheumatic fever may be less effective (Markowitz, 1970). Until recently, the prolonged (even lifetime) prophylaxis has not been questioned; it would now be timely to ask for evidence to support this policy.

The medical profession is currently intensely interested in (preoccupied with?) Hypertensive Disease (400-404). Trials suggest that early detection and diuretic treatment of essential Benign Hypertension (401) lowers mortality from cerebrovascular accidents, although not necessarily affecting the other two main causes of hypertensive mortality - renal failure or cardiovascular disease (Veterans Administrative Cooperative Study Group on Antihypertensive Agents, 1967 and 1970). Since these studies, there has been great activity to screen large populations with the intention of identifying, investigating, and subsequently treating all affected individuals. There are a number of problems in this philosophy (Sackett, 1974). Many of the individuals identified are already aware of their hypertension, but have either not been offered treatment by their physician, or have declined to start or continue such treatment. A further group of patients will have been identified as hypertensive but not told because the physician considered treatment was not indicated. Of those who are truly "new" hypertensives, there are many difficulties in ensuring compliance with the anti-hypertensive regimens. Anti-hypertensive medication will produce moderate to severe side effects in about 30% of patients. Since hypertension alone is almost invariably asymptomatic, one may convert a person who feels well to a patient with distinct and uncomfortable symptoms. For all this medical activity, the gain is not enormous. Savings in cerebrovascular mortality are not of the same order of magnitude as the savings in cardiovascular mortality if one could abolish smoking, for example. There are real dangers to the therapy; these have been underestimated. As

well as the known dangers, some theoretic ones have been pointed out recently. In women, there has been shown an association between Reserpine (once a common anti-hypertensive) and breast cancer. Whether this association will stand the test of further studies remains to be seen. Likewise, Spironolactone, a diuretic used for treatment of hypertension, has also been linked to breast cancer. Persons with ocular hypertension or borderline glaucoma may be more sensitive than most to lowering of systemic blood pressure and it is theoretically possible that lowering the blood pressure would result in precipitation of glaucoma. It would seem prudent to seriously question the worth of hypertension screening and treatment on a large scale until further studies are available. Such studies should include cost-benefit analyses and consideration of iatrongenic morbidity from the screening and treatment. The effect of treatment on mortality should be re-studied, especially with consideration of the newer therapeutic agents.

Ischemic Heart Disease (410-414) is the commonest cause of death in Canada. Acute myocardial infarction and chronic ischemic heart disease probably represent our major public health problem. Unfortunately, evidence for an effective means of prevention is far from conclusive. Primary prevention by means of dietary modification, weight control, exercise, and lipid lowering are advocated without solid evidence. Screening by electrocardiography for secondary prevention is not useful except where applied to airline pilots for the safety of passengers. In this instance, the pilot receives no benefit (but indeed a penalty) for an abnormal electrocardiogram but his passengers are protected by his grounding. There has been an unfortunate tendency in recent years to equate cardiovascular fitness with protection from myocardial infarction. There is almost no evidence to support this point of view. The most changeable risk factor for ischemic heart disease is cigarette smoking (U.S. Dept. of Health, Educ., and Welfare, 1967). Avoidance of cigarettes is well documented as effective primary prevention. It is not yet clear as to what role personality and job satisfaction play in the development of ischemic heart disease but evidence is beginning to accumulate that job

satisfaction may be an effective preventative, with personality type a major risk (Sales and House, 1971; Rosenman et al., 1970). No major programs devoted to prevention of ischemic heart disease can be recommended at this time, except to continue the war against smoking.

Other Heart Diseases (420-429) are not as important as causes of morbidity and mortality. There are no specific programs of primary or secondary prevention for them, except perhaps the sub-acute bacterial endocarditis that might be prevented by prophylactic antibiotics, especially at times of tooth extraction, in persons with rheumatic valvular disease.

Cerebrovascular Disease (430-438) includes two common diseases, cerebral hemorrhage and cerebral thrombosis. Risk factors for these include use of oral contraceptives, systemic hypertension, smoking, and family history. As discussed previously under hypertension, control of systemic blood pressure lowers the risk of cerebral hemorrhage or thrombosis. Avoidance of cigarette smoking would likewise diminish risk. Unfortunately, nothing can be done about family history. Therefore effective primary prevention rests upon avoidance of cigarettes and treatment of systemic hypertension.

Diseases of Arteries, Arterioles, and Capillaries (440-448) include arteriosclerosis, aneurysm, peripheral vascular disease, and certain other conditions. In all of these diseases, the only effective primary preventive measure is avoidance of cigarette smoking. The role of diet is certainly not clear and so programs in this area cannot be recommended at this time.

Diseases of Veins and Lymphatics and Other Diseases of the Circulatory System (450-458) include pulmonary embolism (a common cause of death), phlebitis, varicose veins and hemorrhoids. Pulmonary embolism can be avoided by shunning unnecessary surgery, since it is closely related to post-operative thrombophlebitis. Where surgery is necessary, good post-operative care may reduce the frequency of thrombophlebitis. There is considerable evidence that the oral

contraceptive pill predisposes to thrombophlebitis, although this complication is still relatively rare (Vessey and Doll, 1969). There is no specific preventive program for varicose veins, although they have been related to such diverse causes as diet, exercise, obesity, and girdles. Probably, family history is an important risk factor, while environmental influences remain to be determined. No preventive programs are recommended, although surgery for these veins should probably be conservative, not radical, for least morbidity.

Hemorrhoids, like varicose veins, are a common condition of uncertain etiology. We cannot yet offer any program of effective primary prevention; secondary prevention has no place. Treatment, if any, should be conservative rather than radical, to prevent further complications.

VIII DISEASES OF THE RESPIRATORY SYSTEM

Acute Respiratory Infections (except influenza) (460-466) include our most common maladies. The common cold is included here and for this there is no specific preventive measure. Exposure to cold and wet does not increase the chance of attracting a cold. There are no specific preventive measures, although Vitamin C is now thought to reduce the duration and severity of symptoms from a cold (Anderson et al., 1974).

For acute sinusitis, pharyngitis, and tonsillitis (non-streptococcal) there are no specific preventive measures. For good reason, there are now serious questions asked concerning the efficacy of tonsillectomy, a procedure which has never been well evaluated as a protective measure against recurrent pharyngitis. The other infections in this category also fall into the category of non-preventable at the current time.

Influenza (470-474) includes a number of symptom complexes caused by various types of influenza virus. The prevalent viral strains change from year to year although frequently one year's strain is a variant of the previous year's virus. Vaccines, when available, are usually prepared from the previous year's virus, which, although different, will give some

immunity to the newer strain. However, any emergence of a brand new type of influenza makes vaccine production difficult, as an epidemic may occur before sufficient vaccine is on hand. When vaccines are used, they create an appreciable amount of morbidity from the minor symptoms of the immunization. For a working population, the number of days lost from the immunization program will about equal the number of days lost from influenza if there is no program (Nelson, 1958). The pattern of illness is different, however, in that with immunization, many people are ill for a short length of time; without immunization, fewer people are ill for longer periods of time. Thus, for working populations, immunization may be an elective program in which the risks and benefits should be balanced. Most authorities recommend that "high risk" persons receive immunization against influenza. These are individuals who because of pre-existing cardiac or respiratory disease are prone to die of influenza complications such as bronchopneumonia, and heart failure. There currently is no public health program to immunize this segment of the population; such procedures are left to the private physician to initiate. For unusually virulent influenza strains, some would recommend universal immunization. Preparation of enormous amounts of new and unusual vaccine will usually mean severe reduction in the amount of vaccine required for more routine use. This type of decision, as exemplified by "swine flu vaccine" costs lives.

Pneumonia (480-486) includes a number of types of bacterial and viral pneumonias. None of these are preventable with our current knowledge except, as previously mentioned, by attempting to reduce influenza complications through immunization programs. Since pneumonia is a frequent complication of diseases such as cardiac failure, prevention of the underlying condition may reduce the incidence of pneumonia.

Bronchitis, Emphysema, and Asthma (490-493) are important causes of morbidity and mortality. Since chronic bronchitis often leads to or complicates emphysema, it is a frequent cause of death. Both bronchitis and emphysema are closely related to cigarette smoking and to a lesser extent, to occupational and environmental exposure. Smoking increases not only the duration

of the attack of acute bronchitis, but seems to prolong the length of each episode. Industrial and environmental agents which also give problems include irritant gases, such as ozone and chlorine, particulate matter, arsenic, and fumes from processes such as meat wrapping (meat wrappers' asthma). Primary prevention is devoted to maintaining a clean environment and avoidance of cigarette smoking, especially persons with $alpha_1$-antitrypsin deficiency.

Bronchial asthma is a condition of vague etiology, certainly exacerbated by smoking and/or environmental air pollution, but not easily amenable to prevention at either the primary or secondary level. The treatment of this disease is especially liable to induce iatrogenic illness or death, since the drugs are potent and the routes of administration frequently hazardous (Inman and Adelstein, 1969).

Other Diseases of the Upper Respiratory Tract (500-508) include hypertrophy of tonsils and adenoids, chronic pharyngitis and sinusitis, and miscellaneous other diseases. None of these is important for primary or secondary prevention. Much of the previous discussion of acute tonsillitis and sinusitis could be applied to these items as well. Avoidance of unnnecessary surgery is a most important preventive measure.

Other Diseases of the Respiratory System (510-519) include a number of miscellaneous diagnoses, including some important for prevention. The various pneumoconioses due to silica, coal dust, asbestos, and other dusts are almost entirely preventable by maintenance of a safe workplace. It is unfortunate that Ontario has few standards in this area and most are not enforced, thus condemning large numbers of men to eventually suffer from these pneumoconioses. There is some attempt at annual screening of miners and a few other occupations to detect early change, even though no treatment is available. It is sad to note that even when changes on x-ray are found that indicate pneumoconiosis, the man is not removed from his environment but is allowed to continue to work - usually until he is totally disabled. About 50% of all men entering the mining work force in Ontario are eventually disabled by silicosis.

IX DISEASES OF THE DIGESTIVE SYSTEM

Diseases of the Oral Cavity, Salivary Glands, and Jaw (520-529) are almost entirely dental problems and have little implication for the practice of medicine. They are therefore considered to be outside the terms of reference of this book. The diseases of the salivary glands and tongue are not important for morbidity and mortality and have no specific preventive programs.

Diseases of the Esophagus, Stomach, and Duodenum (530-537) include a wide variety of diseases. The most important of these is peptic ulcer and its variations. In spite of the general impression that psychic stress contributes to development of such ulcers, there is no firm evidence to substantiate this or to allow institution of any preventive program. It is intriguing to note that 50% of people with peptic ulcer visible on x-ray will steadfastly deny any signs or symptoms referable to the disease. Likewise, a number of people who have signs and symptoms highly suggestive of peptic ulcer will have no abnormalities on x-ray. The relationship of stomach ulcer to Type O blood group indicates some genetic influence, but has little or no implication for prevention.

Appendicitis (540-543) is a disease which appears to be decreasing in incidence, for no apparent reason. Etiology is almost totally unknown, and there are no effective means of prevention.

Hernias of the Abdominal Cavity (550-553) are common reasons for elective surgery but cause little mortality. The various hernias are almost always operated upon if discovered, although there is some question that many people might do as well if the hernias were left alone. If persons were as well without surgery, then an appreciable amount of cost and morbidity might be saved. There may be reason to do controlled clinical trials of herniorrhaphy.

Other diseases of Intestine and Peritoneum (560-569) include obstruction, non-infectious gastroenteritis, and a number of miscellaneous classifications of which the most common are probably functional disorders of the intestines (564). The

functional disorders are to a large extent products of a combination of habitual uses or misuse of laxatives. These preparations are extremely popular, especially among the elderly, and can lead to a major dependence upon them. Fortunately, a major amount of morbidity or mortality rarely results from the habitual use of laxatives, but Canadians consume an enormous number of these unnecessary medications. Currently there is intense discussion concerning the role of fiber in the diet and whether or not it would prevent many of the major and minor difficulties in the intestinal tract. One can draw no conclusions at present.

Diseases of Liver, Gallbladder, and Pancreas (570-577) include a number of important causes of morbidity and mortality. Acute and subacute necrosis of the liver is frequently due to toxic causes, such as inhalation or ingestion of carbon tetrachloride. In many instances, the etiology agent is unknown, although occupational causes are probably under-reported.

Cirrhosis of the Liver (571) has a number of causes, the most important of which is chronic alcoholism. Deaths from cirrhosis of the liver have been related directly to national rates of alcohol consumption. The toxic effect of the alcohol is likely multiplied by a relative state of malnutrition. Prevention demands abstinence or moderation; no magic program for this is yet available. Early identification and treatment are not useful.

Cholelithiasis and other diseases of the gallbladder account for an enormous amount of surgery, a moderate amount of morbidity, and a minor amount of mortality. As both scientific articles and the popular press have recently indicated, Canadians are exposed to a great deal of elective gallbladder surgery (Vayda, 1973). The value of this surgery, especially for cholelithiasis without evidence of cholecystitis, remains to be seen.

Pancreatitis (577) is related to both alcoholism and to the complications of peptic ulcer. Primary prevention centers upon avoidance of alcoholism and effective treatment of peptic ulcer. There are no secondary preventive programs.

X DISEASES OF THE GENITOURINARY SYSTEM

Nephritis and Nephrosis (580-584) are important causes of kidney failure and hypertension. Since the major portion of this problem is a post-streptococcal phenomenon, primary prevention and control must be based on prompt and adequate treatment of streptococcal infections. Secondary prevention is not recommended, although some instances of chronic nephritis will be found on investigation of persons identified as being hypertensive.

Other Diseases of the Urinary System (590-599) include a number of important causes of morbidity. Infections of kidney and bladder are extremely common, with etiology poorly understood. Through loss of advertising, many medical journals would cease to exist should a cure or preventative ever be found for urinary tract infections. While many persons with recurrent infections have anatomic abnormalities to predispose to problems, we do not understand the basic etiology. Much work has gone into screening populations, both male and female, for asymptomatic bacteriuria. This work has been guided by the philosophy that many people must have asymptomatic infections which might be identifiable and treatable before the onset of frank disease or damage. Surveys have demonstrated a prevalence of significant bacteriuria in 3-5% of the female population and in 0.03 - 0.5% of the male population (Asscher, 1974). It seems, however, that perhaps 30% of cases of bacteriuria will resolve spontaneously without further treatment. We have, as yet, little evidence to suggest that any anti-microbial therapy is effective in achieving a sterile urine over a long period of time. Persons with bacteriuria have a high incidence of anatomic abnormalities; to how much x-ray and other investigations shall we subject otherwise-healthy persons in order to find out a cause of bacteriuria? It is likely that questions concerning screening for asymptomatic urinary tract infection will have more answers over the next ten years. At this point, however, one would be reluctant to start any new programs unless they were clearly designed to research the natural history of urinary tract infections, and evaluate the

effectiveness and cost of early detection and treatment. Such efforts should be concentrated in females, rather than males, who are at a relatively low risk. The problem deserves a high priority, since about 30% of adults and 40% of children presenting with end-stage kidney failure have chronic pyelonephritis as the cause.

Renal and ureteral calculus is commonly a painful disease, often associated with renal infection and metabolic disease. There are few means of prevention, except for those due to metabolic and iatrogenic causes, where urinary pH control and adequate water intake may reduce the frequency of calculi. Most physicians are knowledgeable in this matter.

Other diseases of the urinary system are not particularly important from the preventive point of view, and no programs are recommended.

Diseases of the Male Genital Organs (600-607) include some important causes of morbidity that contribute little to mortality. Hyperplasia of prostate (600) is almost universal among men over 60 years of age, although it can occur earlier. The etiology of this condition is totally unknown, so primary prevention is unavailable at present. Secondary prevention is possible by routine rectal examination to detect enlargement, but there is no evidence that early treatment is beneficial. There is the distinct possibility that too-energetic treatment of the condition might increase morbidity. Prostatitis and hydrocele (602-603) are problems giving discomfort but no serious illness and offer little opportunity for prevention. Rubric 605, redundant prepuce and phimosis, is of some interest if one considers the practice of routine circumcision. A high percentage of newborns are routinely circumcised for reasons other than religion. Proponents justify the procedure by claiming this prevents later problems of phimosis, is more hygienic, and will diminish the frequency of cancer in the male and his sexual partners. There is almost no data to substantiate this belief, yet every year thousands of male infants are exposed to the danger of hemorrhage, local infection, and hepatitis (Naggan et al., 1976) through unwarranted circumcision. If one is interested in prevention,

then prevention of needless surgery would seem to have some priority, and routine circumcision appears to be an excellent candidate for elimination.

Diseases of the Breast, Ovary, Fallopian Tubes, and Perimetrium (610-6160) include some extremely common non-fatal diseases. Some of these have considerable implication for prevention.

Chronic cystic disease of the breast is a frequent condition which appears to predispose to cancer of the breast. Women with a family history of breast cancer have a higher risk of cystic disease; women with a family history of cystic disease have a higher risk of breast cancer, and women with benign breast cysts stand an increased risk of developing cancer later in life (Morgan et al., 1974). The epidemiology of fibrocystic disease is similar to that of breast cancer; it is a disease which affects the affluent and the nulliparous. There is some evidence to suggest that the oral contraceptive protects against the development of benign breast disease (Vessey et al., 1972). If this is so, then one may hope that the pill will also protect against later development of breast cancer. Unfortunately, studies concerning the effect of the pill on benign breast disease have the same basic flaw: physicians are reluctant to prescribe oral contraceptives for women at high risk of breast cancer. This means that women receiving the pill are low-risk women in whom the expected incidence of benign breast disease would be lower than that of the general population. Thus, comparisons between women on the oral contraceptive and the general population are inherently biased. Primary prevention of chronic cystic disease may not be obtainable in the near future. One can suggest, however, that early detection of this disease is important for another reason: identification of women at high risk of later breast cancer. These women can then be given more aggressive programs for prevention of breast cancer, either through self-examination, professional examination, special techniques, or preferably, a combination of these.

Diseases of fallopian tube and ovary are not particularly important, except as minor causes of morbidity and as a cause of infertility. Other than avoidance of and adequate treatment of

venereal disease, primary prevention is impossible, secondary prevention not worthwhile.

Diseases of the Uterus and Other Female Genital Organs (620-629) include a number of conditions extremely important for preventive practices, especially the avoidance of unnecessary surgery. It is unfortunate that conditions which might be considered variants of the normal are misclassified as diseases and seem to attract surgeons. Chronic cervicitis (620) is an example. Many women have a cervix with the appearance compatible with "chronic cervicitis" but with little or no symptomatology. Since there is no evidence that this condition is deleterious to current or future health, there would seem to be some question as to why it should be vigorously treated if asymptomatic. Unfortunately, the mere appearance of such a cervix sometimes leads surgeons to freeze, burn, or carve to return it to more "normal" appearance. Other diseases of the cervix, with the exception of leukoplakia and dysplasia, are not particularly important. Leukoplakia is generally considered to be premalignant and therefore deserves vigorous treatment (secondary prevention); primary prevention is not available. Dysplasia may be premalignant; patients with dysplasia must be kept under careful surveillance with repeat cytology.

Infective diseases of the uterus, vagina, and vulva, as classified in this section, are not important sources of mortality although there is a certain amount of morbidity. Vaginitis especially is more frequently found in sexually-active women, and in the case of monilial vaginitis, may be caused or aggravated by oral contraceptive intake. No primary or secondary programs are proposed.

Uterovaginal prolapse is an extremely common condition for women over age 40. It is sometimes symptomatic, giving problems of urinary incontinence on coughing or straining. While gynecologic surgery for these conditions is moderately successful, one might question why a hysterectomy so frequently accompanies the repair of a cystocele, rectocele, or urethrocele. Except for good obstetrical technique at the time of childbirth, there are no preventive measures for uterovaginal prolapse. Unnecessary surgery should be avoided.

Malposition of the uterus, although classified as a disease, is probably only a variant of normal, and usually causes no symptoms or problems. It is unusual that this would require any treatment or operations. No measures of prevention are suggested.

The other diseases of the uterus and disorders of menstruation have little or no implication for the practice of preventive medicine, except to avoid over-treatment, especially for menstrual irregularities.

Menopausal symptoms (627) is a disease rubric of considerable controversy. There is, of course, some question of whether this is a disease or natural set of symptoms associated with normal endocrine changes. In recent years, there has been a tremendous increase in the amount of treatment of these symptoms by the use of estrogen replacement therapy. A fortuitous combination of declining obstetrical practice, an abundant supply of obstetricians and gynecologists, availability of synthetic or natural estrogen fractions, and a large number of women entering the menopause have combined to make menopausal symptoms an eminently "treatable" disease. Unfortunately, in recent months, there have been at least two reports linking such treatment with later development of endometrial cancer (see p. 47). Although we have no methods for prevention of menopausal symptoms, we can prevent untoward side-effects by reserving potentially dangerous treatment for only the most serious problems.

Female sterility and other diseases of the female genital organs have no specific preventive programs associated with them and no recommendations for same.

XI COMPLICATIONS OF PREGNANCY, CHILDBIRTH, AND THE PUERPERIUM

Prenatal care represents one of the greatest applications of preventive medicine to medical practice. There are well-defined normal and empirical standards with a number of specific routines and procedures to be followed. Unfortunately, the efficacy of all of the standard prenatal care procedures

have not been proven. There are certain standards which would elicit no arguments. These include:

1. Rh- and ABO typing with monitoring for antibodies, where indicated;
2. serologic test for syphilis, preferably in the first trimester;
3. determination and further monitoring of maternal blood pressure;
4. routine urinalysis throughout pregnancy;
5. determination and monitoring of maternal hemoglobin.

The procedures suggested above are the cornerstones of obstetrical care. Identification of the Rh-negative mother and monitoring for antibodies allows an earlier intervention to save the child that might be affected with hemolytic disease. It also allows the physician to immunize the Rh-negative mother at the time of delivery should she be carrying an Rh-positive child which would then give her subsequent difficulty in future pregnancies. Syphilis serology is performed, not because the disease is common, but because of the disastrous consequences to the fetus from a disease that is still treatable when identified during the first trimester. Blood pressure and urinalysis are monitored to identify any signs of toxemia of pregnancy, a serious complication. Urinalysis allows for detection of either pyelitis or diabetes, either of which may be precipitated by pregnancy and will require special treatment. The hemoglobin is checked to maintain an adequate level in times of an increasing drain on body iron stores, and the possibility of folic acid deficiency anemia developing from the pregnancy. These are the standard unquestioned procedures of prenatal care.

At time of pregnancy, many women are unsure as to whether or not they previously had rubella (German measles). Rubella infection in the first trimester frequently leads to major birth defects. Where the previous history is at all uncertain, many physicians will draw a sample of blood to determine the rubella antibody titer. Should the titer show previous immunity, the woman is not at any appreciable risk of contracting the disease during her pregnancy. If the antibody titer is low, she is considered to be at risk. Should any vague viral infection

occur during the first half of the pregnancy, a repeat titer can be performed to see whether or not the disease is rubella. If the titer has increased from the previous level, rubella is presumed and the woman is a candidate for a therapeutic abortion, if she so wishes. A more logical approach would be to immunize all females prior to childbearing. Since it is generally recommended that this immunization occur at least 3 months before conception, the woman must be either young enough, not at risk of pregnancy, or employing suitable contraceptive methods. Although the vaccine is believed to be effective in the reduction of congenital anomalies, there has been a question that the previous immunity may prevent only the rash and not the in utero damage. This would mean that immunization, by raising antibody titers, would not allow us to detect infection during pregnancy. Although this area requires further clarification, all children, both male and female, should receive rubella immunization at least once, and perhaps twice before age 16.

The role of amniocentesis during pregnancy is still not entirely clear. Although it is a relatively safe procedure, there are complications, including spontaneous abortion (Brit. Med. J. 4(5995), 1975). In the case of Down's syndrome (mongolism), the frequency of the disease increases with maternal age. While only 4% of births are to women over age 40, this group produces 40% of the mongoloid population (Penrose, 1961). Amniocentesis can, with a high degree of sensitivity and specificity, detect the chromosome abnormality so that the woman may avail herself of an abortion. But what about the woman under age 40? It is generally conceded that age 30 is far too young, with a disease frequency that does not warrant the procedure. Women between the ages of 35 and 40 are probably on the borderline and may pressure physicians to perform the test. Like any screening or diagnostic test, amniocentesis is neither 100% sensitive nor 100% specific. Even with a high specificity rate (low rate of false positives) the number of false positives may approach or exceed the number of true positives if the disease is of very low frequency. Thus, the hazards of amniocentesis, including false diagnosis, must be weighted against the potential gains. There is no doubt that where a

mother has previously had a child with Down's syndrome, amniocentesis is indicated. The amniocentesis has a number of other uses, including the detection of fetal damage due to Rh imcompatibility, the diagnosis of Tay-Sachs disease *in utero*, and the detection of certain other physical or metabolic abnormalities. An amniocentesis for Tay-Sachs disease or Rh incompatibility will be based on the results of the parents' blood tests and poses little problem in decision-making. For other metabolic disorders, it is probably best used for women who have given birth to a previously affected child, and where there is suspicion that the disorder is genetic and may recur. Although most controversy surrounding amniocentesis concerns detection and "prevention" of Down's syndrome, other conditions have been considered. An interesting analysis for spina bifida has recently appeared (Hagard et al., 1976). For many other obstetrical reasons, including the frequency of Down's syndrome, women over 40 should not become pregnant: this would appear to be the most effective primary prevention.

Currently there is considerable uncertainty concerning the amount of weight gain optimal for pregnancy. Since toxemia is more frequent among women with excessive weight gain, most pregnant women are advised to limit their weight gain. In the case of obese women, some have managed to lose weight during pregnancy. There is now evidence to suggest that women with little or no weight gain during pregnancy have babies that are small for their dates (Ademowore et al., 1972). It is not clear that this lessened weight is necessarily harmful. It is not certain that avoidance of weight gain necessarily prevents toxemia; while the two are related, they may occur coincidentally; the weight gain may not be causative for toxemia. Until the matter is clarified, it would appear that a moderate amount of weight gain (up to 20 lbs.) is reasonable, but that severe dietary restrictions or excesses should be avoided. Adequate nutrition is important, and vitamin and mineral supplementation usually recommended.

Smoking during pregnancy has been reported in more than 40 studies to produce smaller babies, greater fetal wastage, and perhaps affect the subsequent health and/or intelligence of the

offspring. Since smoking appears to be of no possible benefit to fetus or mother, the pregnant woman should be strongly encouraged not to smoke. Many obstetricians will be reluctant to emphasize this preventive measure.

Screening of asymptomatic bacteriuria during the first trimester is a question of considerable controversy. About 20% of women with such asymptomatic bacteriuria will, later in pregnancy, develop clinical acute pyelonephritis, or other evidence of renal tract infection. Kidney infection is related to an increased incidence of toxemia. Should we then screen the women early in pregnancy for bacteriuria? Unfortunately, there is no evidence that the early treatment will prevent subsequent toxemia. This is an area of considerable research interest in which an answer should be forthcoming within the next 5-10 years. In the meantime, we are sparing in our use of all drugs, including antibiotics.

We have ample evidence, from a series of disasters including thalidomide and stilbestrol, that pregnant women should be exposed to as few drugs as possible during their pregnancy, especially during the first trimester. This includes both prescribed and non-prescribed compounds, and other medical and non-medical drugs. To control drug exposure is difficult, especially since the woman may be continuing on a previous medication not realizing she is pregnant until approximately one month after conception. This month is probably the most important in life. An example of this type of problem is the woman who continues to take oral contraceptives after (for some reason) becoming pregnant. The rate of defects among offspring so exposed appears to be high (Janerich et al., 1974). A certain amount of prevention can be accomplished by cautious prescribing, education of the patient who is likely to become pregnant, and careful history-taking when seeing a patient in the first trimester. Like drugs, radiation exposure should be avoided during pregnancy, wherever possible. Women undergoing any kind of pelvic or abdominal diagnostic x-ray should be questioned concerning the possibility that they are pregnant. If they are not practicing an effective form of birth control and have been exposed to the risk of pregnancy, then such

radiologic examinations should probably occur only during a menstrual period or within the first ten days of its onset. This would prevent radiation exposure of the embryo at its most sensitive age. Such a policy should be implemented at all radiologic facilities, including those operated by hospitals, physicians, and chiropractors.

The traditional routine of prenatal visits is monthly until 5 months, then every two weeks until seven months, and then weekly until delivery. This routine indicates our preoccupation with the mechanism of delivery which may not be the most important time of pregnancy, when considered in terms of prevention. Because of the extreme importance of first trimester events, there would appear to be a rationale for confirmation of pregnancy as early as possible, and intensive surveillance for infectious diseases (especially viral), drug and radiation exposure, and environmental hazards. Only through such close scrutiny might we identify and prevent more hazards. The current standards of prenatal care might well be reviewed by an expert committee, which should include at least one epidemiologist.

Obstetrical practice has always emphasized good technique of delivery as being preventive medicine for both mother and child. The competent obstetrician recognizes the high risk mother (the very young, very old, those with many previous pregnancies) and is prepared to deal with them at the time of delivery. Good delivery techniques also minimize the trauma to both newborn and mother. It would be inappropriate for a book of this nature to discuss these techniques in detail. The reader is referred to any standard textbook of obstetrics.

The Complications of Pregnancy, Childbirth, and Puerperium (630-678) will not be discussed individually, since most were covered in the previous few pages. Abortion (640-645), while included in the same section, deserves a few remarks. Primary prevention of abortion involves adequate contraception available to all at risk. Even with the most sophisticated methods of our current technology, there will still be a number of contraceptive failures, so that abortion services will always be required. With competent medical care, abortion is of low

hazard, and may be, in fact, less risky than some forms of contraception. The later undesirable sequelae of abortion are psychological (as yet unmeasured) and the possibility of an incompetent cervical os with habitual spontaneous abortion in later pregnancies. This type of complication has not been well studied.

XII DISEASES OF THE SKIN AND SUBCUTANEOUS TISSUE

Infections of the Skin and Subcutaneous Tissue (680-686) include a number of common problems such as boils, cellulitis, and impetigo. Except through personal hygiene, no primary preventive measures are available. Secondary prevention may, on occasion, mean screening of populations to detect carriers of impetigo who are spreading it to others. This occasionally happens with school children.

Other Inflammatory Conditions of Skin and Subcutaneous Tissue (690-698) include a wide variety of common skin problems of varying etiology. Dermatitis is a major public health problem responsible for more time lost due to industrial disease than any other single cause. Prevention depends upon avoidance of exposure to damaging or sensitizing chemicals in the home or workplace. The public is generally ignorant of the potentially harmful effects of common substances. Dermatitis can also be produced or aggravated by various medications, either topical or systemic. A large number of drugs give rise to skin eruptions, through the mechanisms of either photosensitivity or allergy. Prevention depends upon conservative prescribing patterns, recognition of drug reactions, and proper history taking to elicit the story of previous episodes. Special attention should be paid to dermatitis confounded by use of sensitizing agents on a skin already damaged. Many topical preparations commonly in use (either prescribed or non-prescribed) are more likely to injure or sensitize than cure.

Other Diseases of Skin and Subcutaneous Tissue (700-709) include a number of miscellaneous entities with little application for prevention, except where they result from medical mismanagement (e.g. bedsores).

XIII DISEASES OF THE MUSCULOSKELETAL SYSTEM AND CONNECTIVE TISSUE

Arthritis and Rheumatism (710-718) are common causes of morbidity and rare causes of mortality. These problems are responsible for a high percentage of visits to physicians' offices. Unfortunately, no methods of primary or secondary prevention are known to be effective. The physician's main opportunity for prevention comes in the intelligent choice of treatment. Most drugs used for arthritic conditions are capable of serious systemic side effects, and even death. Therapeutic irradiation for ankylosing spondylitis is of limited value in the disease and will lead to an excess of leukemia and lymphoma among the people so treated (Court-Brown and Doll, 1957). It should, therefore, be used with extreme caution.

Osteomyelitis and Other Diseases of Bone and Joint (720-729) present no opportunities for prevention, with current knowledge, with the possible exception of control of superficial staphylococcal and streptoccal infections. There are no specific programs to recommend. Displacement of the intervertebral disc might be prevented by proper attention to body mechanics, especially in lifting, but sitting may be a more important factor (Kelsey and Hardy, 1975). There are no medical methods of either primary or secondary prevention.

Other Diseases of Musculoskeletal System (730-738) are a miscellaneous mixture of conditions from bunion to myasthenia gravis. Except for non-medical items such as adequate footwear, no preventive measures are available.

XIV CONGENITAL ANOMALIES

Primary prevention of congenital anomalies is best accomplished by avoidance of the known etiologic factors during pregnancy (drugs and infections) and adherence to advice on genetic counselling, where applicable. Unfortunately, the etiology of most congenital anomalies is poorly understood, so in most instances it is impossible to attribute a particular problem to any known genetic or environmental factor. Well

understood syndromes, such as the anomalies following rubella, are the exception rather than the rule. As discussed earlier concerning prenatal care, we have likely neglected, to our disadvantage, surveillance of women during the first trimester of pregnancy for environmental influences, infections, and ingestion of chemicals. We have not yet explained seasonal variations of abnormalities of the central nervous system, congenital heart defects, or even birth itself. There would appear to be potent environmental influences. There is a frightening suspicion that chemicals capable of causing cancer might also produce congenital anomalies. In counties of Ohio where there are vinyl chloride plants and vinyl chloride cancers, there are higher rates of birth defects (Infante, 1976). Operating room personnel, exposed to gases that chemically resemble known carcinogens, have higher rates of birth defects if they carry that child while working in the operating room (Knill-Jones et al., 1972). We know that the rubella virus and a few others cause certain known syndromes. But what is the effect of the common cold or influenza?

No one has yet extensively examined the interaction of genetic factors and environmental influences in the production of congenital anomalies, but it would seem reasonable to expect that this interaction is important, since no other type of disease occurs without some genetic predisposition and environmental force. In many instances, we can not separate our increased familial incidence from genetic predisposition. This is an important distinction since an increase in familial incidence may reflect a common environmental agent rather than a genetic weakness.

For certain congenital anomalies, parents who have one affected offspring will come under a different surveillance during subsequent pregnancies, possibly with amniocentesis (for metabolic and chromosomal abnormality) or fetal x-ray examination for skeletal or cranial abnormalities. Such surveillance is a poor form of prevention, and is not a substitute for adequate primary prevention.

For some abnormalities, identification in early life is important for adequate treatment. Examples of this include

congenital dislocation of the hip, esophageal atresia, and some congenital heart disease. In these instances, secondary prevention may allow treatment, survival, and eventually a normal life. For most congenital anomalies, secondary prevention is not important.

XV PERINATAL MORBIDITY AND MORTALITY

Specific causes of perinatal morbidity and mortality will not be considered in this volume, since each of the conditions has been discussed elsewhere.

XVI SYMPTOMS AND ILL-DEFINED CONDITIONS

Categories 780-789 include:

"...the most ill-defined conditions and symptoms that point with perhaps equal suspicion to two or more diseases or to two or more systems of the body and without the necessary study of the case to make a final diagnosis. Practically all titles in this group could be designated as 'not otherwise specified' or 'unknown etiology', or as 'transient'". (W.H.O., Geneva, 1967)

The reader will realize that these symptoms and ill-defined conditions are almost impossible to prevent with our current state of ignorance. There are minor exceptions such as prevention of hoarseness by avoidance of shouting and the prevention of flatulence by not swallowing air. This is not to say that the ill-defined conditions are unimportant, especially as causes of morbidity leading to use of medical services and all the potential complications of investigation and treatment. More research into the causes of prevention of some of these simple yet vague conditions might have more implication for medical care costs than prevention of a disease as common as lung cancer.

XVII EXTERNAL CAUSES OF DISEASE AND INJURY

This section does not correspond exactly to the similarly-named section of the International Classification of

Disease which provides code names for items such as bayonet wounds, pushed from a high place, and medical misadventure. Under the discussion of common causes of morbidity and mortality, I pointed out that accidents and violence were an outstanding public health problem but not amenable to approach through medical services. A similar situation exists for much of environmental and occupational disease.

It was estimated that in 1974, Canadians lost 11,000,000 man-days from work due to industrial disease or accident (Chisholm, 1976). This far exceeds the number of man-days lost through industrial strife and work stoppage. Each year, in the workplace, we manage to kill about 1500 Canadians. Any current estimates of carnage in the workplace are conservative since much industrial disease is not correctly attributed to its point of origin. It should be remembered that industrial disease serves as a sentinel to the community; it is rare for any particular hazard to be totally confined to a manufacturing area. Not only do most dangerous substances escape from the plant into the community, workers also take home with them some of the workplace hazards. If a man works with asbestos and has his clothes laundered at home, his wife may well develop asbestosis or lung cancer as a result. Naturally, in Ontario, she is not covered by Workmen's Compensation since she is not considered "employed". Likewise, if a zoo keeper takes home amoebiasis and spreads it to his family, his illness is compensable; theirs is not.

Industry and Workmen's Compensation Boards have concentrated, in the past, on accident prevention. In this they have had some limited success. Because of the insidious nature of industrial disease, and the failure of the medical profession, the provincial government, and the manufacturers to recognize it, such disease is at best neglected and at worst, concealed as a public health problem. In Ontario, the worker has no right to monitor the health conditions of his working place; there are almost no legal standards governing the conditions of the workplace; there is poor enforcement of the few existing standards. If a worker complains to his Union about a health hazard, the Union reports it to the Ministry of

Labour, who may report it to the Ministry of Health, who may make an inspection. On the basis of their inspection, a report will go to the Ministry of Labour, who will then notify the management of the industry. The report to management is confidential and the workers are not told the result of the survey or the contents of the report. A recent chain of industrial disease epidemics has focussed public attention on this area and there is some hope for new legislation.

There would seem to be little usefulness in reciting the health effects of hundreds of harmful chemical and biologic agents currently in the workplace or general environment. The primary preventive measure is always the same - separation of man and agent. Secondary prevention frequently becomes no more than a system of biologic monitoring where we allow the substance to be present in quantities sufficient to detect in employees. Workers are not informed of health hazards, either by their employer or by government. How can we expect men to avoid hazards if they are denied knowledge?

As a start toward primary prevention in the workplace, I suggest that each industry, old or new, employing more than 10 employees, prepare a Health Impact Statement. The Statement would list known or suspected hazards of the processes used and the materials handled in that particular industry, along with methods for avoidance of hazards and a schedule for detection of health problems. The Statement would be updated and reviewed periodically by the Ministry of Health and would be provided to every worker at the time of hiring. Such a document would go far towards encouraging primary prevention.

As an added form of monitoring of industrial hazards, all Canadian provinces should begin keypunching the occupation which is currently on the certificate of death but not now entered into the computer. For the living, there should also be established a series of special risk registers for individuals in industries known or suspected as health hazards.

The medical responsibility for occupational health is clear. There must be greater attention paid to occupational medicine as a career and better training for those involved in the field. Individual physicians in every discipline have a

responsibility to recognize and report suspected industrial disease so that appropriate action may be taken. The medical profession must also provide leadership in identifying the hazards and ensuring their control.

Chapter 6

Recommendations for Prevention

Table 6 contains a summary of some of the recommendations for prevention of specific diseases. The table should not be used without reference to Chapter 5. There are at least three recurrent recommendations: cessation of smoking, improved environmental health, and changes of medical practice habits. These three are difficult but all have potentially great benefits. To a certain extent, success in these areas will depend upon the political courage of the government, the competence of the various responsible Ministries, and the awareness and enthusiasm of physicians.

TABLE 6

ICD #	Disease	Current Prevention in Ontario	Recommendations
000-009	Intestinal Infectious Diseases.	Sanitation.	No change.
010-019	Tuberculosis.	Tuberculin testing; Contact tracing; Chemoprophylaxis; X-ray of high-risk groups.	No change.
020-027	Zoonotic Bacterial Disease.	Sanitation.	No change.
030-039	Other Bacterial Diseases.	Immunization.	Immunization programs directed at immigrants.

ICD #	Disease	Current Prevention in Ontario	Recommendations
040-046	Poliomyelitis & other Entero-viruses of the Central Nervous System.	Immunization.	No change, but reconsideration of live vs. killed polio vaccine.
050-057	Viral Diseases Accompanied by an Exanthum.	Immunization.	No change.
060-068	Arthropod-borne Viral Diseases.	Mosquito control.	Question spraying.
070-079	Other Viral Diseases.	Sanitation; Animal immunization; Post control immunization.	Extend rabies immunization to selected groups. Reconsider mumps vaccine.
080-089	Rickettsioses & Other Arthropod-borne Diseases.	Sanitation.	None.
090-099	Syphilis and Other Venereal Diseases.	Contact tracing; Limited screening; Proplylactic eye drops for newborns.	Trial of Abandoning contact tracing.
100-104	Other Spirochetal Diseases.	Sanitation.	None.
110-117	Mycoses.	None.	None.
120-129	Helminthiases.	Sanitation; Food Inspection.	None.
130-136	Other Infective and Parasitic Diseases.	Personal hygiene.	None.

ICD #	Disease	Current Prevention in Ontario	Recommendations
140-149	Malignant Neoplasms of Lip & Buccal Cavity.	None, except limited cytologic screening, early treatment of pre-malignant lesions.	Further restrictions on smoking.
150-159	Malignant Neoplasms of Digestive Organs & Peritoneum.	No major programs.	None, except reduction of exposure to asbestos and vinyl chloride.
160-163	Malignant Neoplasms of Respiratory System.	No major programs.	Further restrictions on smoking; Better occupational health programs; Reduction of environmental carcinogens.
170-174	Malignant Neoplasms of Bone, Connective Tissue, Skin.	No major programs.	Educational programs re sunlight.
174	Malignant Neoplasm of Breast.	No major programs.	Clinical trials of self-examination and thermography.
180	Malignant Neoplasm of the Uterine Cervix.	Extensive screening.	Epidemiologic guidelines for screening.
	Malignant Neoplasm of the Uterine Corpus.	No major programs.	Improved regulation of drug use.

ICD #	Disease	Current Prevention in Ontario	Recommendations
188	Malignant Neoplasm of the Urinary Bladder.	No major programs.	Improved industrial health programs.
333	Tay-Sachs Disease.	Moderate voluntary program.	Review provincial policy.
380-389	Disease of Ear & Mastoid Process.	No major programs.	Trials of prophylactic antibodies; Improved occupational programs for noise control.
390-398	Rheumatic Heart Disease.	Sulfonamide and penicillin prophylaxis.	Critical review, possibly clinical trials.
400-404	Hypertension.	Large amount of screening in both public and private sectors.	Better measurement, re-evaluation; Consideration of program hazards.
410-414	Ischemic Heart Disease.	Numerous sporadic attempts at screening, diet & exercise, cessation of smoking.	More vigorous attack on smoking.
430-438	Cerebro-vascular Disease.	No major programs except for hypertension & smoking.	More vigorous attack on smoking.

ICD #	Disease	Current Prevention in Ontario	Recommendations
470-474	Influenza.	Immunization of high-risk and some occupational groups (sporadic).	Improve logic of program, especially to protect those persons most in need due to other conditions.
490-493	Bronchitis, Emphysema, and Asthma.	Some anti-smoking campaigns, air pollution control.	More vigorous attention to smoking & environmental control.
510-519	Pneumo-coniosis.	Worker x-ray, reduction of occupational dust exposure.	Increase vigour of programs to reduce current carnage.
590-592	Kidney-Bladder Infections.	No major programs.	Clinical trials of early detection and treatment.
605	Redundant Prepuce.	Routine circumcision.	Stop the fad and fancy.
610	Chronic Cystic Disease of Breast.	No programs.	Trial of screening to identify women at higher risk of later cancer.
627	Menopausal Symptoms.	Widespread estrogen replacement.	Reduced prescribing.
	Pregnancy & Childbirth.	Routine prenatal care & delivery.	Reconsideration, by expert committee, of care standards.

Chapter 7

Responsibilities for Prevention

The previous chapters on prevention of specific diseases may have created an artificial ship of presumably water-tight compartments. In reality, diseases co-exist with each other, occur without clear separation as to type, and must be considered in a more holistic fashion. The International Classification obscures the fact that many different diseases have similar causes. For example, cigarette smoking contributes to cancer of the larynx, bronchus, lung, and bladder, while also killing people through coronary artery disease, stroke, and peripheral vascular disease. Exposure to lead may give abdominal colic in an adult and learning difficulty in a child. We see a cancer incidence rate rising at about 1% per annum with no clear evidence as to which specific sites or which etiologic agents to blame. Our lack of improvement in efficacy of treatment makes it obvious that if we cannot afford prevention, we may quickly become an endangered species. We base the argument for prevention on survival, not economics.

Most of our successes in avoidance of disease and prolongation of life have come, not from medical procedures, but from improvement of the human condition. Pasteurization of milk has prevented far more tuberculosis than all of the chest x-rays and case finding programs. Potable water has saved more infants' lives than all of the centers of neonatology. Our current biologic knowledge, and the lessons of history, suggest that prevention must be practiced first by society, then by doctors. In fact, doctors, with their known proclivity to induce disease, may be among the poorest equipped to practice effective prevention. That is not to say physicians have no responsibility in the matter. They have a particular responsibility to prevent some diseases, to educate patients, and to influence public policy. For effective prevention, action must be taken at individual, local, provincial, national, and supranational levels.

In spite of the current popular thought that each of us

dies of his own excesses, the individual has but a limited opportunity to practice prevention. After all, once he stops smoking, lessens his drinking, and begins exercising, what else is left? He might lose some weight, but, like exercise, the benefit of this has not been clearly demonstrated. He has little control over the air he breathes, his working environment, or his prior experiences in utero. His most effective means of preventing premature death - avoidance of smoking and wearing seat belts - are behaviors almost totally unaffected by his experience with doctors. That is not to deny the extreme importance of individual preventive behaviors; these must be encouraged, either through legislation or more innovative methods of promotion.

Local government and non-governmental organizations have a particular responsibility to maintain a healthy environment. Such considerations involve the use of mass transit to diminish air pollution, the safe planning of city streets, the separation of sidewalks from traffic to diminish inhalation of exhaust fumes, and many other facets of daily living by local ordinance. I would include at this level the responsibility of the employer, who should aim to make the workplace the safest possible rather than to effect the minimal compliance with provincial standards. Local health departments must take a more active interest in the issues of environmental and occupational health. The medical officers of health should also scrutinize more carefully the quality of care delivered in his community; prevention of iatrogenic disease is primary prevention.

At the provincial level, health is a responsibility shared among almost all ministries and not limited to Health. Miners die of accidents, silicosis, and cancer. Preventive solutions are more often developed by engineers than physicians. The Ministry of Transport and the Attorney-General's office cooperate in highway legislation. Numerous other examples from other ministries can also be cited. The Provincial Government also has a special responsibility to pass legislation and develop an enforcement apparatus to protect the health of workers. Government must ensure that workers have the right to monitor their own working environment and to be represented on

health and safety committees. There is also a provincial government responsibility to see that toxic wastes are not dumped into the air, water, or other environment. The Provincial Government must protect health as well as economic interests.

The role of the federal government in prevention is severely limited by jurisdictional boundaries. In certain areas, such as the approval of drug and food additives, the federal Ministry of Health and Welfare is vital to our protection. Compilation of national health statistics to identify health progress or problems is another important role, probably underestimated in importance.

It would be unfortunate if federal officials continue to consider support of fitness programs as synonymous with preventive medicine. Most of these programs attract the persons who presumably need them the least - persons already fit. And, as discussed earlier, we have no evidence to suggest that such programs will improve our eventual health.

The federal government has shown a distressing lack of leadership in important areas. They have not provided or supported resource centers for epidemiology and environmental health, where manpower is scarce. Until recently, expensive high-technology medical care procedures have not been evaluated by the federal government; money has been transferred to the provinces to pay for services. It may be that the current series of task forces on screening for cervical cancer and other controversial programs may provide a useful model for future problem-solving.

The supranational organizations, especially those connected with the United Nations, have an important role to play in the protection of homo sapiens. Once again, this responsibility is not limited to the World Health Organization, but transcends institutional boundaries. The International Labour Organization, United Nations Environment Program, and the World Bank may be more important than the World Health Organization. Such agencies must see to it that economic development is not synonymous with industrial disease. In economic aid, water supplies must take priority over neurosurgical units.

Preventive medicine has a peculiar communications problem. We speak softly but carry a small stick. Scientists are frequently reluctant to enter into public debate; bureaucratic professionals protect empires and political masters; we have few effective spokesmen. The epidemiologists who identify environmental hazards must speak, not only to other epidemiologists, but to politicians, businessmen, and workers.

Professionals in various levels of government must appreciate that the health of the public transcends interdepartmental rivalries, personal ambition, and departmental image.

In the future, prevention will be applied in the home, the consulting room, in the workplace, and in the street. No profession enjoys a monopoly in its practice; no profession is devoid of responsibility for its application. We are still waiting for the emergence of a few leaders. They will be easily identifiable, since they will walk across the waters to our shores on a warm June day.

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PANORAMA DE LA MORTALITE AU CANADA

Le graphique ci-inclus donne un aperçu global des principales causes de décès* pour chaque tranche d'âge et de sexe au Canada (1971). Ainsi sont mises en évidence, du moins jusque vers 50-60 ans, certaines causes fortement liées au style de vie, telles les accidents de véhicule à moteur, la cirrhose du foie ou les maladies coronariennes. On y voit aussi les différences majeures entre hommes et femmes, tant dans la nature que dans le nombre des décès.

Seules ont été retenues les causes responsables d'au moins 5%** des décès à l'intérieur de chaque tranche d'âge et de sexe. Une cause peut donc n'être importante que relativement à un groupe d'âge et de sexe, telle la leucémie chez les jeunes enfants. Les 13 premières rubriques de décès indiquées sur le graphique représentent les deux tiers de la mortalité après 5 ans.

Quelques-uns des traits dominants de ce graphique sont indiqués ci-dessous.

1) On remarque tout d'abord l'importance considérable des *accidents de véhicule à moteur* et des *autres accidents**** (bleu foncé et bleu clair). Ceux-ci atteignent surtout les jeunes et représentent, de 5 à 40 ans, entre la moitié et les deux tiers des décès chez les hommes. Chez les femmes, entre 5 et 30 ans, les accidents sont responsables de 30% à 50% des décès.
2) Le *suicide* (noir) apparaît dès l'âge de 15 ans.
3) Chez les hommes, à partir de 40 ans, les *maladies coronariennes* (rouge) deviennent et demeurent la cause majeure de mortalité, responsable d'environ 40% des décès à partir de 50 ans. Chez les femmes, elles ne constituent la cause dominante qu'à partir de 50 ans, mais sont beaucoup moins fréquentes que chez les hommes. Même si l'on n'a pas établi de façon définitive le degré d'influence de notre style de vie sur l'apparition des maladies coronariennes, on sait néanmoins qu'il existe une forte relation entre celles-ci et une nourriture trop grasse, le fait de fumer avec excès, le manque d'exercice ou le stress de la vie urbaine.
4) Le cancer frappe à presque tous les âges mais affecte les femmes beaucoup plus tôt. Le *cancer du poumon* (vert foncé) dépasse chez les hommes le seuil de 5% à partir de 45 ans, tandis que le *cancer gastro-intestinal* (vert pâle) n'apparaît qu'après 55 ans. Chez les femmes, le *cancer du sein* (vert) et le *cancer de l'utérus et de l'ovaire* (jaune-vert) prédominent dès 30 ans.
5) Les *maladies respiratoires* (jaune) et le *cancer du poumon*, largement liés à l'habitude de fumer, sont responsables de 15% des décès masculins entre 55 et 70 ans.
6) La *cirrhose* (gris), fortement reliée à l'abus d'alcool, atteint surtout les hommes entre 40 et 50 ans.
7) On notera finalement que de 5 à 10 ans le taux de mortalité masculine surpasse de 50% le taux féminin, et que de 15 à 70 ans la mortalité des hommes est presque constamment supérieure ou égale à *2 fois* celle des femmes. Entre 15 et 25 ans la mortalité masculine atteint même *3 fois* la mortalité féminine; ceci est essentiellement dû aux accidents de véhicule à moteur, autres accidents et suicide.

ERREURS D'INTERPRETATION A EVITER

Comme indiqué dans la note 2 sur le graphique, les superficies des cercles sont proportionnelles aux nombres absolus de décès et la simple comparaison de 2 cercles ne permet donc pas d'évaluer directement si le *taux de mortalité* d'un groupe est plus important que celui d'un autre. Le taux de mortalité, exprimé en "pour mille", pour chaque tranche d'âge et de sexe s'obtient en divisant le nombre de décès (d) par la population correspondante (p). Nous indiquons ci-dessous 3 exemples d'erreurs d'interprétation auxquelles pourrait conduire la méconnaissance de ce fait:

a) Le nombre de décès chez les hommes de 30 à 34 ans (1,090) est inférieur à celui de la tranche d'âge précédente 25-29 (1,176) bien que le taux de mortalité chez les hommes de 30 à 34 ans ($\frac{1,090}{660.9} = 1.65$ pour mille) soit supérieur à celui de la tranche d'âge plus jeune 25-29 ($\frac{1,176}{800.7} = 1.47$ pour mille)

b) De même, si les décès des femmes de plus de 80 ans sont plus nombreux que ceux des hommes de la même catégorie d'âge (23,285 et 21,016) le taux de mortalité des femmes est néanmoins plus faible que celui des hommes de cette tranche d'âge ($\frac{23,285}{201.3} = 116$ pour mille, $\frac{21,016}{140.3} = 150$ pour mille)

c) Le fait que le suicide disparaisse de nos graphiques, après 45 ans chez les femmes et 50 ans chez les hommes, n'est pas dû à une baisse de l'incidence de cette cause, mais seulement à une diminution de son importance relativement aux autres raisons pour des âges plus avancés.

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* Extrait de "La statistique de l'état-civil, 84-202, 1971" publié par Statistique Canada, et utilisant la Liste internationale intermédiaire "A" de 150 rubriques.

** Ce critère de 5% a été choisi arbitrairement afin de se restreindre à un petit nombre de causes de décès. On notera qu'une partie des causes retenues sont identiques à celles de la classification utilisée (accidents de véhicule à moteur: AE 138, Cancer du sein: A 54. . .) alors que d'autres sont des groupements effectués pour correspondre à une entité plus globale (autres accidents: AE 139-146, maladies respiratoires: A 89-96, cancer gastro-intestinal: A 46-49, et cancer de l'utérus et de l'ovaire: A 55, 56, 58D).

*** La rubrique "autres accidents" (AE 139-146) concerne des accidents d'origines très variées: noyade, chute, incendie, accident de travail, etc.

(English on the other side)

PANORAMA OF MORTALITY IN CANADA

The enclosed chart gives a broad overview of the prevailing causes of death* for each sex and age group in Canada (1971). It demonstrates the importance of the contribution of our lifestyle to mortality up to middle age, for example motor vehicle accidents, cirrhosis of the liver, heart disease,etc. It also emphasizes the different mortality patterns and rates for males and females.

The causes included are responsible for at least 5%** of the deaths within each sex and age group, thus one cause may be important only relative to certain age and sex groups, such as leukemia among young children. The 13 first cause-groups used in this chart represent two thirds of the total deaths after the age of 5.

There are a few features of this chart which should be emphasized.

1) Noticeable immediately is the tremendous importance of *motor vehicle accidents* and *all other accidents**** (dark blue and light blue), which account for more than half and up to two thirds of deaths in young men between the ages of 5 and 40 years. Among women these two causes of death are of lesser importance but still account for from 30% to 50% of deaths between 5 and 30 years.
2) *Suicide* (black) is an important cause of death in those as young as 15 years.
3) *Coronary heart disease* (red) becomes and remains the major cause of death in men from age 40 on. After age 50 it accounts for about 40% of all deaths in males. It is less frequent in females and only becomes the major cause of death after age 50. The degree to which our lifestyle accounts for this disease is still open to question. However, there is a strong relationship to a high fat diet, excessive smoking, lack of exercise and the stress of urban living.
4) Cancer strikes at most ages but at a much earlier age among women. *Lung cancer* (dark green) in males rises above the 5% threshold at age 45 years, while *gastro-intestinal cancer* (light green) appears after the age 55. On the other hand, *cancer of the breast* (green) and of the *uterus and ovary* (yellow-green) appear in women as young as 30 years.
5) Deaths due to *respiratory diseases* (yellow) and *lung cancer* are strongly related to cigarette smoking. They account for about 15% of deaths among men aged 55 to 70.
6) *Cirrhosis* (grey) only appears in this chart between the ages of 40 and 50 in males, related largely to alcohol abuse.
7) Finally, it should be noticed that from 5 to 10 years male mortality exceeds female mortality by more than 50% and from 15 to 70 years male mortality rate is almost constantly in excess or equal to *twice* that of females. Note especially that between the ages of 15 and 25 male mortality reaches *three times* the female mortality, largely due to motor vehicle accidents, other accidents and suicide.

PITFALLS TO AVOID

As indicated in note 2 on the chart, the areas of the circles are proportionate only to the absolute number of deaths, therefore one is unable to determine if the *mortality rate* of one group is greater than another by simple comparison between two circles. The mortality rate, expressed in "per thousand", for each age and sex group is obtained by dividing the number of deaths (d) by the corresponding population (p).

Shown hereunder are 3 examples of pitfalls resulting from ignorance of this fact:

a) The number of deaths among males aged 30 to 34 (1,090) is less than that of the preceding age group, 25-29 (1,176) although the mortality rate among males aged from 30 to 34 ($\frac{1,090}{660.9}$ = 1.65 per thousand) exceeds that of the 25-29 group ($\frac{1,176}{800.7}$ = 1.47 per thousand)

b) In the same way, deaths among women over 80 are more numerous than those among men of the same age group (23,285 and 21,016), nevertheless the mortality rate in women is less than that of the men from the same age group ($\frac{23,285}{201.3}$ = 116 per thousand, $\frac{21,016}{140.3}$ = 150 per thousand)

c) The fact that suicide disappears from the chart after age 45 for females and age 50 for males is not due to a decrease in incidence but merely to a decrease in importance compared to other causes.

(français sur l'autre côté)

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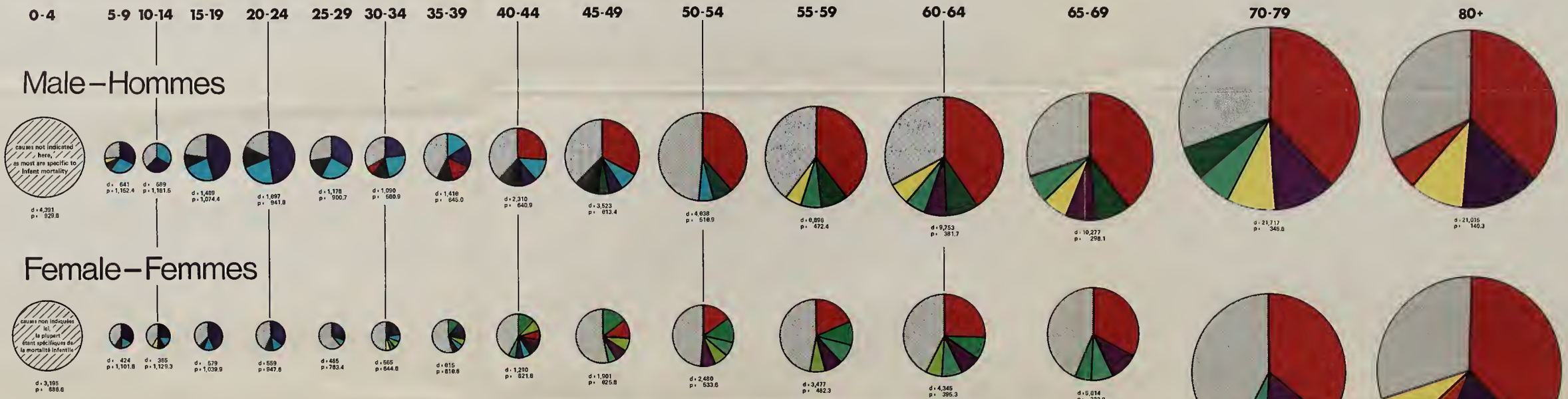
* Taken from "Vital statistics, 84-202, 1971" published by Statistics Canada, using the International Intermediate "A" List of 150 cause-groups.

** The arbitrary criterion of 5% has been selected so as to limit the causes to a manageable number. It must be noted that some causes of death listed are identical to those of the classification used (motor vehicle accidents: AE 138, Breast Cancer: A 54. . .) whereas others correspond to groupings representing a more comprehensive entity (other accidents: AE 139-146, respiratory diseases: A 89-96, gastro-intestinal cancer: A 46-49, and cancer of the uterus and ovary: A 55, 56, 58D).

*** Other accidents (AE 139-146) is an aggregate of accidents from very diverse causes such as drowning, falls, fire, industrial accidents, etc.

Major causes of death for each sex and age group
Causes principales de décès pour chaque tranche d'âge et de sexe

Canada 1971



Legend - Légende

- Motor vehicle accidents / Accidents de véhicule à moteur — AE 138
- All other accidents / Autres accidents — AE 139-146
- Suicide — AE 147
- Respiratory diseases / Maladies respiratoires — A 69-96
- Cirrhosis of liver / Cirrhose du foie — A 102
- Lung cancer / Cancer du poumon — A 51
- Breast cancer / Cancer du sein — A 54
- Gastro-intestinal cancer / Cancer gastro-intestinal — A 46-49
- Cancer of the uterus and ovary / Cancer de l'utérus et de l'ovaire — A 55, 56, 56a
- Leukemia / Leucémie — A 58
- Coronary heart disease / Maladies coronariennes — A 83
- Cerebrovascular accident (stroke) / Maladies cérébrovasculaires (congestion cérébrale) — A 85
- Other arteriosclerotic diseases / Autres formes d'artériosclérose — A 88
- All other causes (each causing less than 5% of deaths within each sex and age group) / Toutes les autres causes (responsables individuellement de moins de 5% des décès dans chaque tranche d'âge et de sexe)

Source: Vital Statistics, 1971, Catalogue 84-202, Statistics Canada
Le Statistique de l'Etat Civil, 1971, Catalogue 84-202, Statistique Canada

Scale (number of deaths) / Echelle (nombre de décès): 4 000, 1 000

d: number of deaths by sex and age / nombre de décès suivant l'âge et le sexe

p: population by sex and age (000's) / population suivant l'âge et le sexe (en milliers)

Notes

1) – In each circle major causes of death are arranged in decreasing order of magnitude.
– Dans chaque cercle les causes principales de décès sont indiquées par ordre décroissant.
2) – The area of each circle is proportional to the number of deaths in each sex and age group. (The death rate can be calculated using the two figures under each circle).
– Les surfaces de chaque cercle sont proportionnelles aux nombres de décès de chaque tranche d'âge et de sexe. (Les taux de décès peuvent être calculés en utilisant les deux nombres figurant sous chaque cercle).

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